signal xplorer™

DL9500/DL9700 Series
Digital Oscilloscope
OPERATION GUIDE

YOKOGAWA
Yokogawa Electric Corporation

IM 701331-02E
3rd Edition

Thank you for purchasing the DL9500/DL9700 Series Digital Oscilloscope (DL9505L/DL9510L/DL9705L/DL9710L, hereafter referred to as the DL9500/DL9700).
The purpose of this operation guide is to familiarize the first-time user with the basic operations of the DL9500/DL9700.
There are two additional user's manuals for the DL9500/DL9700. One is the DL9500/DL9700 User's Manual (IM701331-01E) which explains all the functions of the DL9500/DL9700. The other is the DL9500/DL9700 Communication Interface User's Manual (IM701331-17E, CD-ROM) which details only the communication functions. Read these manuals along with this operation guide.

Notes

- The contents of this manual are subject to change without prior notice as a result of continuing improvements to the instrument's performance and functions. The figures given in this manual may differ from those that actually appear on your screen.
- Every effort has been made in the preparation of this manual to ensure the accuracy of its contents. However, should you have any questions or find any errors, please contact your nearest YOKOGAWA dealer.
- Copying or reproducing all or any part of the contents of this manual without YOKOGAWA's permission is strictly prohibited.

Trademarks

- Adobe, Acrobat, and PostScript are trademarks of Adobe Systems Incorporated.
- For purposes of this manual, the TM and ® symbols do not accompany their respective trademark names or registered trademark names.
- Other company and product names are trademarks or registered trademarks of their respective holders.

Revisions

1st Edition: July 2007
2nd Edition: June 2008
3rd Edition: April 2009

3rd Edition : April 2009 (YK)
All Rights Reserved, Copyright © 2007 Yokogawa Electric Corporation

Contents

Front Panel Parts and Functions 3

Parts of the Screen 6

Basic Key and Rotary Knob Operations 9

Introduction of the Main Functions 11

Preparation 16

Connecting the Power Supply 16

Turning ON/OFF the Power Switch 16

Connecting the Probes 17

Connecting the Logic Probes 18

Observing the Analog Signal Waveforms 19

Displaying Waveforms on the Screen 19

Changing the Waveform Display Conditions 21

Changing the Trigger Settings 23

Measuring Waveforms 25

Zooming in on Waveforms 26

Observing Logic Signals 27

Displaying Logic Waveforms on the Screen 27

Changing the Display Conditions for Logic Signals 29

Changing the Trigger Settings 32

Measuring Logic Signals 33

Printing and Saving Waveforms 34

Front Panel Parts and Functions

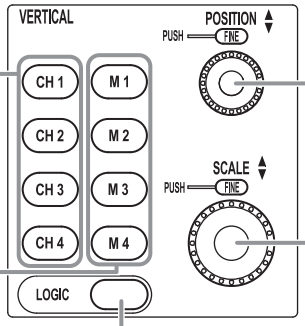
This section describes the names and functions of the keys and knobs on the DL9500/DL9700 front panel. For details on each item, see the respective chapter or section in the user's manual indicated by the ▶ mark.

Vertical Axis

CH1 to CH4 keys ▶ Sections 5.1 to 5.14
Displays a menu used to turn ON/OFF the display of analog signal input channels and set the vertical position, coupling, probe type, offset voltage, bandwidth limit, expansion or reduction of the vertical axis, linear scaling, and waveform labels. Press any of these keys before operating the SCALE knob to select the channel that is controlled using the SCALE knob. Each CH key illuminates when the corresponding channel display is ON.

M1 to M4 Keys ▶ Chapter 9 and 14
Sets waveform computation or sets items related to the reference waveform. Each M key illuminates when the corresponding channel display is ON.

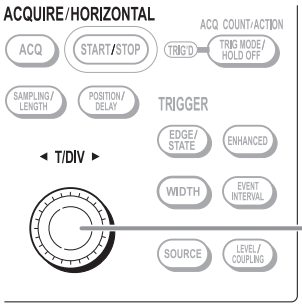
LOGIC Key ▶ Sections 5.15 to 5.19
Displays a menu used to set the logic signal display (grouping, displayed order, bus display, and state display), skew adjustment, threshold level, label, etc. Pressing this key and then operating the POSITION knob sets the vertical display position of the logic signal. Pressing this key and then operating the SCALE knob sets the vertical display size of the logic signal.



POSITION Knob ▶ Section 5.3
Changes the center position when you change the voltage range. This knob has a push switch feature. You can press the knob to switch the setting resolution. If you press the knob and Fine illuminates, the setting resolution is set to fine.

SCALE Knob ▶ Section 5.7
Sets the vertical scale. Press any of the CH1 to CH4 and M1 to M4 keys before turning this knob to select the source waveform. If you change the setting when waveform acquisition is stopped, the new setting takes effect when you restart waveform acquisition.
This knob has a push switch feature. You can press the knob to switch the setting resolution. If you press the knob and Fine illuminates, the setting resolution is set to fine.

Horizontal Axis (Time Axis)



T/DIV knob▶ Section 5.8
Sets the time axis scale. If you change the setting while waveform acquisition is stopped, the setting takes effect when you restart waveform acquisition.

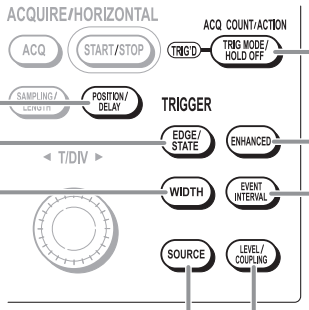
Trigger

POSITION/DELAY Key ▶ Sections 6.2 and 6.3
Displays a menu used to set the trigger delay and trigger position.

EDGE/STATE Key ▶ Sections 6.6 to 6.9
Displays a menu used to set the edge/state trigger. Press any of the EDGE/STATE, ENHANCED, WIDTH, and EVENT INTERVAL keys to select the trigger type. The key that you press illuminates to indicate that it is selected.

WIDTH Key ▶ Sections 6.10 to 6.12
Displays a menu used to set the width trigger.

SOURCE Key ▶ Chapter 6
Displays a menu used to set the trigger source.



TRIG MODE/HOLD OFF Key ▶ Sections 6.1 and 6.4
Displays a menu used to set the trigger mode and hold off time.

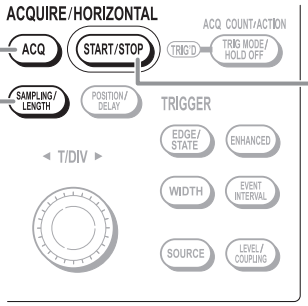
SHIFT+TRIG MODE/HOLD OFF Key (ACQ COUNT/ACTION) ▶ Sections 7.8 to 7.16
Displays a menu related to the action-on-trigger and GO/NO-GO functions.

ENHANCED Key ▶ Sections 6.13 to 6.19
Displays a menu used to set the TV trigger and serial bus trigger.

EVENT INTERVAL Key ▶ Sections 6.20
Displays a menu used to set the event trigger.

LEVEL/COUPLING Key ▶ Section 6.5
Displays a menu used to set the trigger coupling, HF rejection, window comparator, etc.

Waveform Acquisition



ACQ Key ▶ Sections 7.1 and 7.2
Displays a menu used to set the waveform acquisition mode (acquisition mode and high resolution mode).

SAMPLING/LENGTH Key ▶ Sections 7.3 to 7.6
Displays a menu used to set the record length, repetitive sampling, interleave, and interpolation.

START/STOP Key ▶ Section 4.7
Starts/Stops waveform acquisition according to the trigger mode. The key illuminates while waveform acquisition is in progress.

Common Operations, Display, Computation, Analysis, and Search

Arrow Keys (◄, ►, ▲, and ▼ Keys)
The left and right arrow keys are used to move numeric entry digit (cursor). The up and down arrow keys are used to enter a value.

SET Key
Applies the menu item that you selected using the rotary shuttle.

RESET Key
Resets the numeric entry to the default value.

Rotary Knob
Used to change the settings and move the cursors.

CURSOR Key ▶ Section 10.1
Displays a menu used to perform cursor measurements.

PARAM Key ▶ Sections 10.2 and 10.3
Displays a menu used to perform automated measurement of waveform parameters and statistical processing.
SHIFT+PARAM Key (TELECOM TEST) ▶ Section 10.4
Displays the telecom test menu.

WINDOW1 and WINDOW2 Keys ▶ Sections 10.5 to 10.9
Displays a menu used to set the XY display; FFT analysis; histogram, trend, and list of waveform parameters; etc. The key illuminates when the display is ON.

FORM Key ▶ Sections 8.2 to 8.5 and 8.8
Displays a menu related to the screen display.

ACCUM Key ▶ Section 7.7
Displays a menu related to the accumulated waveform display.
SHIFT+ACCUM Key (ACCUM CLEAR) ▶ Section 7.7
Clears the accumulated waveforms.

Numeric Keys
Used to enter values, file names, etc.

MAG Dial ▶ Section 8.1
Turn this dial during zoom display to specify the magnification of the target vertical or horizontal axis.

INTENSITY Key ▶ Section 7.7
Changes the intensity of the accumulated waveforms.

ZOOM1/ZOOM2 Key ▶ Sections 8.1 and 10.10 to 10.13
Displays a menu related to the waveform zoom display and data search (search & zoom function).
SHIFT+ZOOM1/ZOOM2 Key (DISP1/DISP2) ▶ Section 8.1
Displays a menu related to the zoom waveform arrangement.

SHIFT Key
Press the key once to illuminate the key. The function marked in purple characters above each key is activated. Pressing the key again clears the shifted condition.

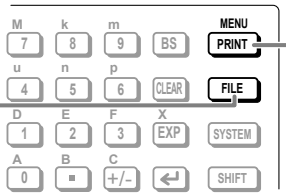
SETUP Key ▶ Sections 4.4 and 4.5
Displays a menu used to initialize the settings to factory defaults; perform auto setup, which automatically sets the DL9500/DL9700 according to the input signal; store or recall setting parameters; and so on.

HELP Key
Turns ON/OFF the help window that provides description about the procedure.

HISTORY Key ▶ Chapter 11
Displays a menu used to display and search waveforms using the history memory function.
SHIFT+HISTORY Key (HISTORY CLEAR) ▶ Section 11.1
Clears the displayed history waveform.

Printing Screen Image and Saving/Loading Data

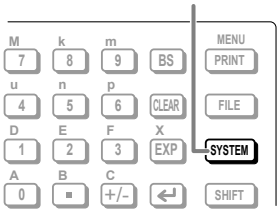
FILE key ▶ Sections 13.4 to 13.8 and 13.10 to 13.13
Displays a menu used to save or load various data from an external storage media such as a PC card or USB memory and operate files.



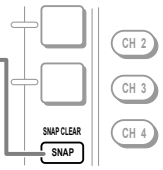
PRINT Key ▶ Sections 12.2 to 12.4 and 13.9
Prints screen images and saves screen image data.
SHIFT+PRINT Key (MENU) ▶ Sections 12.2 to 12.4 and 13.9
Displays a setup menu used to print screen images to the built-in printer, USB printer, or network printer as well as a setup menu used to save screen image data to an external storage media such as a PC card or USB memory.

Calibration, Ethernet Communications, and Other Operations

SYSTEM Key ▶ Sections 3.7, 4.8, 13.14, chapters 15, 17, and 18
Displays a menu related to the date/time, calibration, PC connection method, network, message language, click sound, self-test, formatting of the internal memory or internal hard disk, USB communication functions, and list display of settings. Displays also the system information (available options and firmware version).



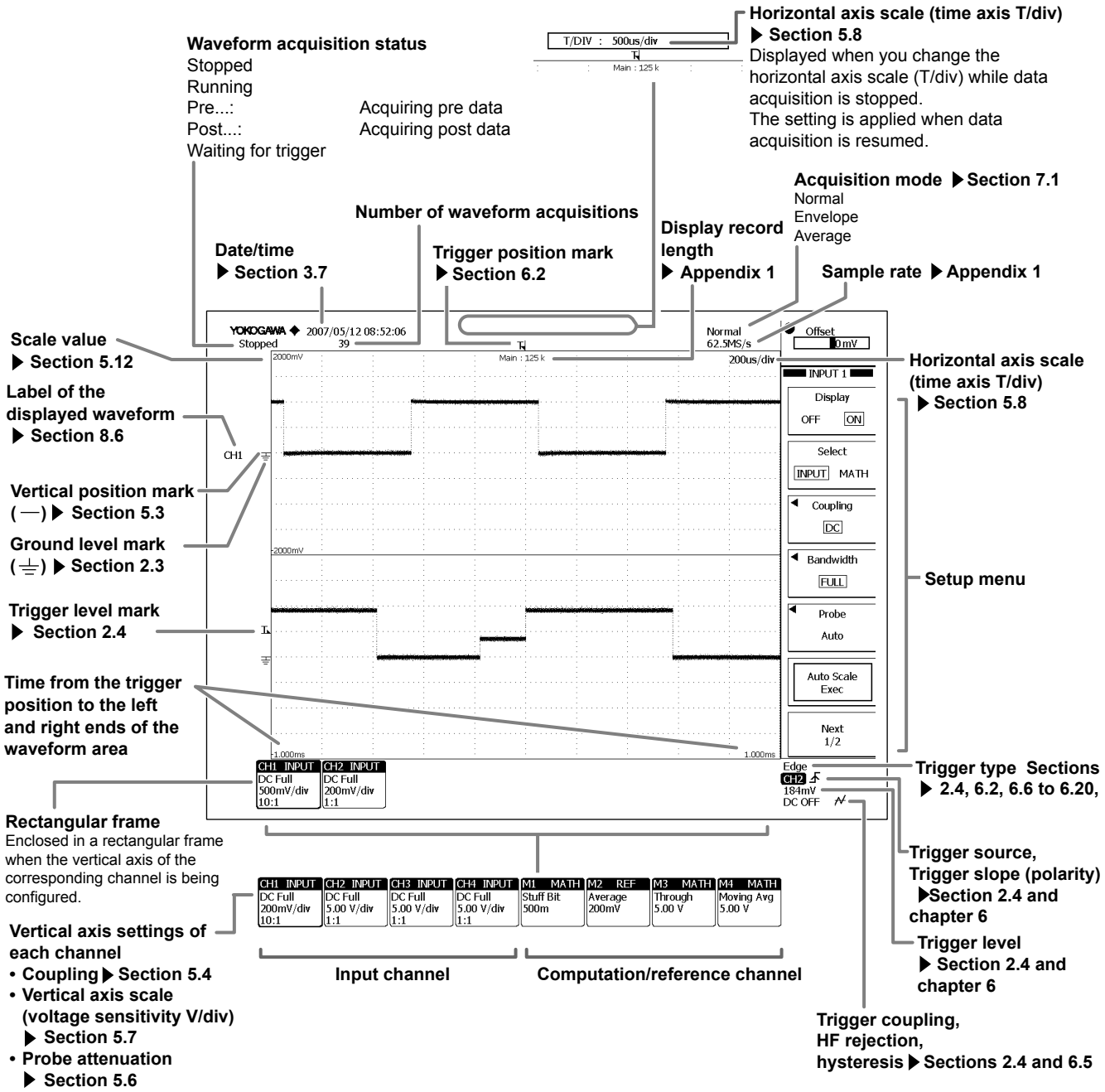
SNAP Key ▶ Section 8.7
Takes a snapshot and retains the current waveform on the screen in white.
SHIFT+SNAP Key (SNAP CLEAR) ▶ Section 8.7
Clears the snapshot waveforms.



Parts of the Screen

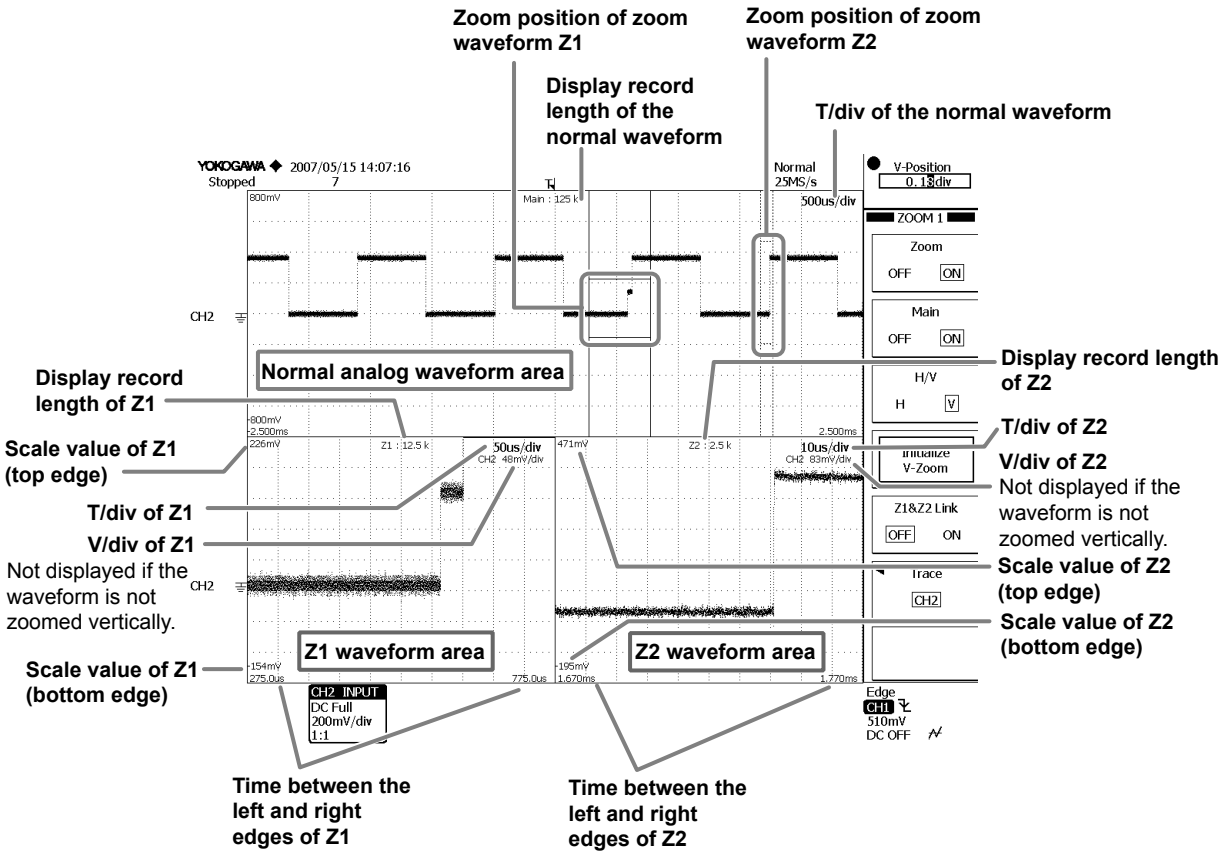
This section describes the menus and symbols that appear on the DL9500/DL9700 screen. For details on each item, see the respective chapter or section in the user's manual indicated by the ▶ or ● ● ●▶ mark.

Screen Showing the Waveforms of Normal Analog Signals



Screen Showing the Zoom Waveforms

●●●▶ Section 8.1, “Zooming the Waveform” in the user’s manual


Zoom position of zoom waveform Z1
Zoom position of zoom waveform Z2
Display record length of the normal waveform
T/div of the normal waveform
Normal analog waveform area
Display record length of Z1
Scale value of Z1 (top edge)
T/div of Z1
V/div of Z1
Not displayed if the waveform is not zoomed vertically.
Scale value of Z1 (bottom edge)
Z1 waveform area
Z2 waveform area
Display record length of Z2
T/div of Z2
V/div of Z2
Not displayed if the waveform is not zoomed vertically.
Scale value of Z2 (top edge)
Scale value of Z2 (bottom edge)
Time between the left and right edges of Z1
Time between the left and right edges of Z2

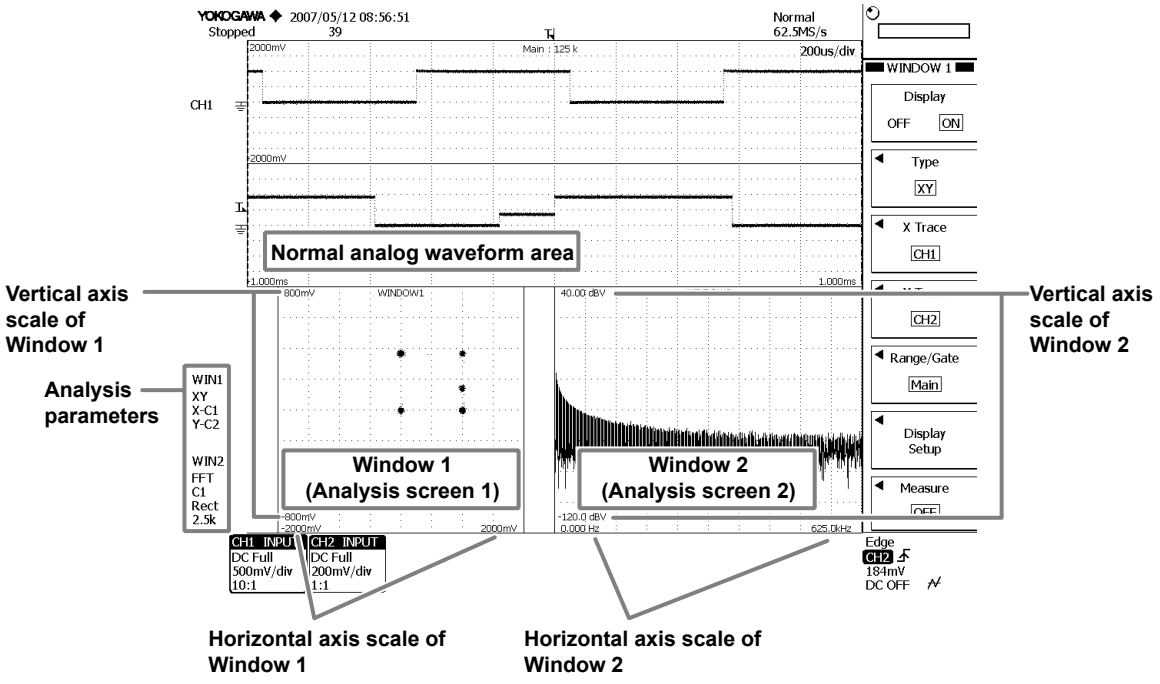
Screen Showing the Analysis Results

●●●▶ Section 10.6, “Viewing the Phase Between Measured Waveform on the XY Display)” in the user’s manual

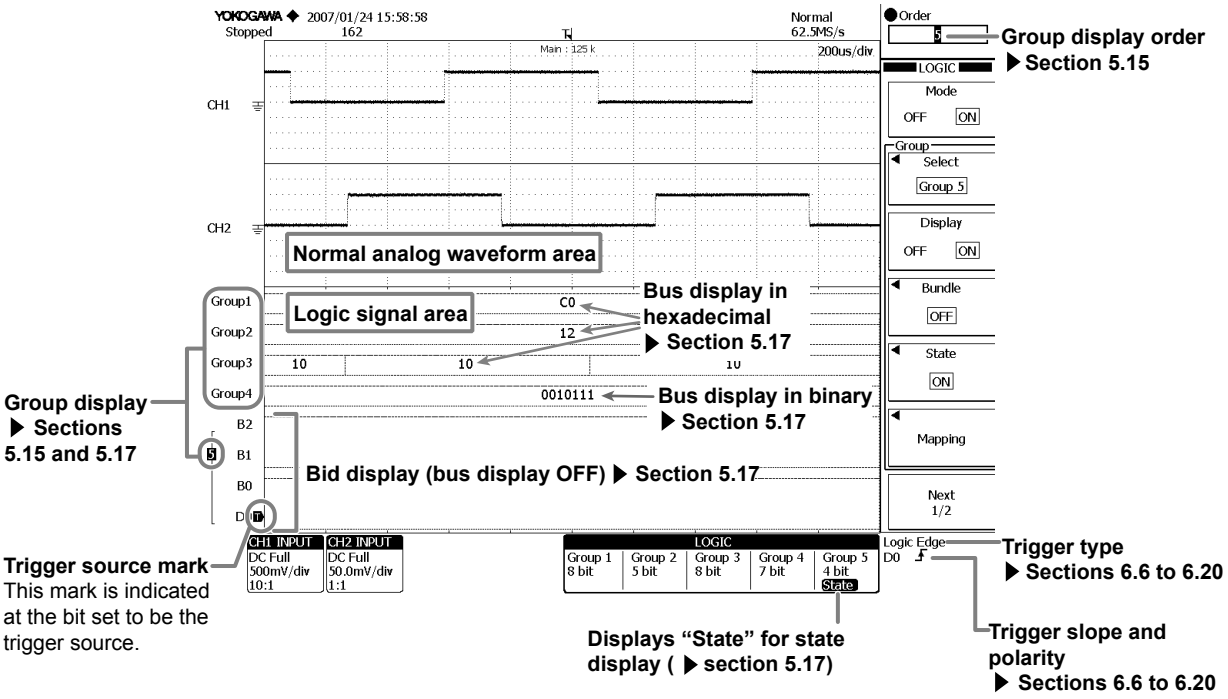
●●●▶ Section 10.7, “Performing FFT Analysis” in the user’s manual

●●●▶ Section 10.8, “Displaying a Histogram, Trend, or List of Automatic Measurement Waveform Parameters” in the user’s manual

●●●▶ Section 10.9, “Displaying Frequency Distribution for a Specified Area (Accum Histogram)” in the user’s manual


Normal analog waveform area
Vertical axis scale of Window 1
Vertical axis scale of Window 2
Analysis parameters
Window 1 (Analysis screen 1)
Window 2 (Analysis screen 2)
Horizontal axis scale of Window 1
Horizontal axis scale of Window 2

Screen Showing Logic Signals



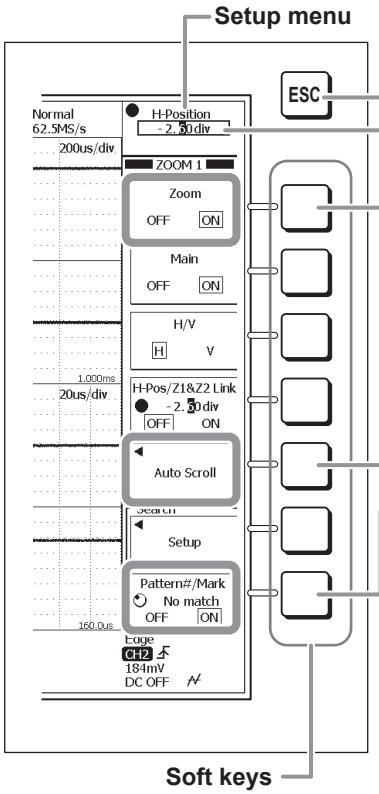
Basic Key and Rotary Knob Operations

This section describes key and rotary knob operations which are basic operations for setting the DL9500/DL9700.

Basic Key Operations

Operations When a Setup Menu Is Displayed

ZOOM 1 Menu (Menu that appears when ZOOM 1 is pressed)



ESC key
Clears a setup menu or a setup dialog box.

Turn the rotary knob to change the setting.

A type of menu in which the item is selected from the displayed choices
(ON or OFF in this case)
The selected item switches each time you press the soft key.
The selected item (ON in this example) is highlighted.

A type of menu in which a selection menu is opened for selecting items (with a ◀ mark)
Press the soft key to display the selection menu.
Press a soft key corresponding to the item you want to select.

A type of menu in which the item is selected using the rotary knob (with ◕ and ◴ marks)
Press a soft key to select a menu you want to control using the rotary knob (◕ : selected, ◴ : not selected).
Turn the rotary knob to change the setting.

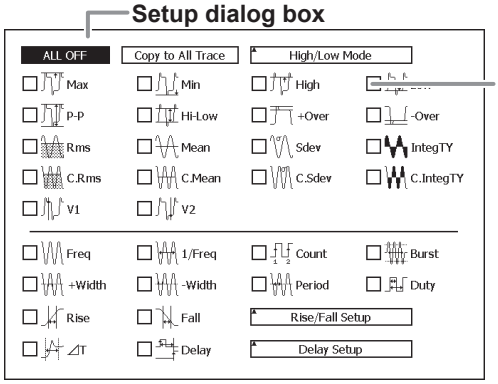
Note

How to display the setup menu marked with purple characters on the front panel
Press the SHIFT key to illuminate the SHIFT key, and then press the key corresponding to the setup menu marked in purple.

Operations When a Setup Dialog Box Is Displayed

Waveform Parameter Setup Dialog Box

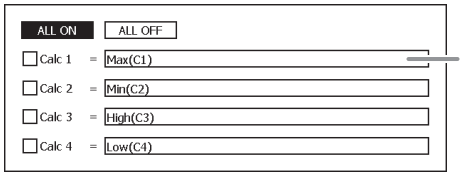
(When the Item soft key is pressed on the setup menu that appears when PARAM is pressed)



Use the rotary knob or arrow keys to select the item you want to set.

Press the SET key to select or deselect items.
A ✓ mark is displayed for the selected items.

(When these soft keys in the setup menu are pressed while the setup dialog box above is displayed: Area/Calc > Calc)



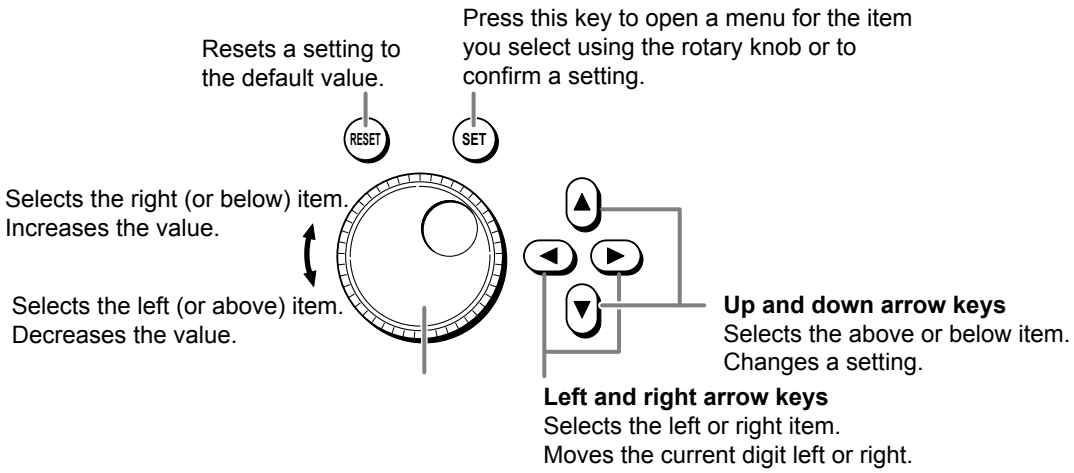
Press the SET key to open a box used to enter a value or characters.

Note

Press the ESC key to clear a setup menu or a setup dialog box from the screen.

Basic Rotary Knob Operations

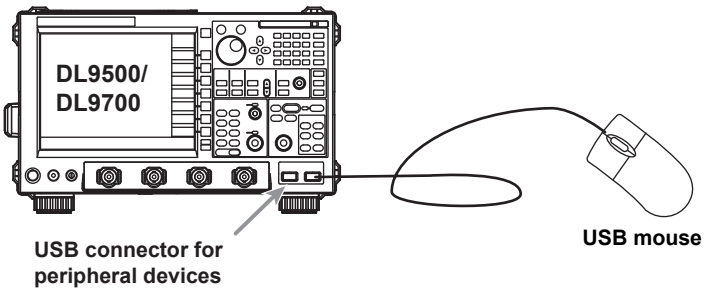
Selecting an Item or Setting a Value

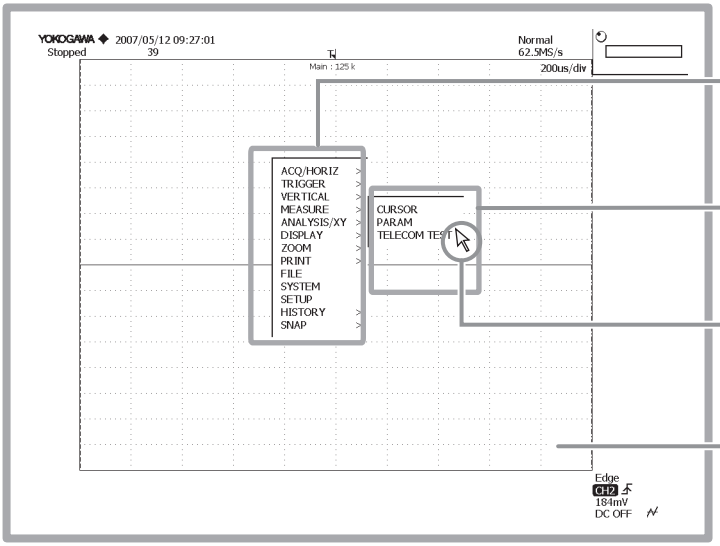

Resets a setting to the default value.
Press this key to open a menu for the item you select using the rotary knob or to confirm a setting.
RESET
SET
Selects the right (or below) item. Increases the value.
Selects the left (or above) item. Decreases the value.
Up and down arrow keys
Selects the above or below item.
Changes a setting.
Left and right arrow keys
Selects the left or right item.
Moves the current digit left or right.

Convenient Feature Operation Using a USB Mouse

Section 4.3, "Operating the DL9500/DL9700 Using a USB Keyboard or a USB Mouse" in the user's manual.

By connecting a USB mouse to the USB connector for peripheral devices on the front panel, you can use a USB mouse to perform the same operations as you would using the front panel keys of the DL9500/DL9700.





Top menu
Right-click on the screen to show the names of each key on the front panel as a top menu.

Sub menu
For items with a lower hierarchy under the top menu, a sub menu is displayed.

Pointer
Move the pointer to the item you want to select and left-click. The setup menu corresponding to the selected item appears.

Left-click an area outside the menu to show the previous setup menu.
The setup menu clears if the setup menu that is showing is the top level menu.

Introduction of the Main Functions

This section describes the main functions of the DL9500/DL9700. For details on each item, see the respective chapter or section in the user's manual indicated by the ▶ or ●●▶ mark.

Triggers for Analog Signals

●●▶ **Chapter 6, "Triggers" in the user's manual**

The triggers can be classified into three main types: edge/state triggers, width triggers, and enhanced triggers.

Edge/State trigger

Edge
A trigger is activated on the rising or falling edge when the trigger source passes through a specified trigger level. You can set the trigger source* to the input signal, external trigger signal, or commercial power supply that is supplying power to the DL9500/DL9700.
▶Section 6.6

Edge (Qualified)
A trigger is activated on the edge of a single trigger source while the signal status of each input channel is meeting a specified condition (qualification).
▶Section 6.7

Edge (OR)
A trigger is activated when any of the edge conditions is met among multiple trigger sources.
▶Section 6.9

State
A trigger is activated when the signal status of each input channel meets or no longer meets a specified condition (state). A trigger can also be activated by checking the condition on the edge of a specified clock signal.
▶Section 6.8

Width trigger

Pulse
A trigger is activated by determining whether the pulse width of a single trigger source is longer or shorter than a specified determination time.
▶Section 6.10

Pulse (Qualified)
A trigger is activated when a pulse trigger condition is met while the signal status of each input channel is meeting a specified condition (qualification).
▶Section 6.11

Pulse State
A trigger is activated when the relationship between the time over which the signal status of each input channel meets or does not meet a specified condition (state) and the specified determination time is met. A trigger can also be activated by checking the condition on the edge of a specified clock signal.
▶Section 6.12

Enhanced trigger

TV
A trigger is activated on a video signal.
▶Section 6.13

Serial
A trigger is activated on the data pattern of a serial bus signal.
▶Section 6.14

I^2C
A trigger is activated on the start condition, address/data pattern, Non-ACK, general call address, start byte, or high-speed mode of an I^2C Bus signal.
▶Section 6.15

CAN
A trigger is activated on the SOF, error frame, data frame, or remote frame pattern of a CAN Bus signal.
▶Section 6.16

LIN
A trigger is activated on the rising edge of the break delimiter of a LIN Bus signal.
▶Section 6.17

SPI
A trigger is activated on the data pattern of a SPI Bus signal.
▶Section 6.18

UART
A trigger is activated on the Stop Bit of all data frames of an UART Bus signal.
▶Section 6.19

* Trigger source refers to the signal that is used in checking the trigger condition.

Triggers for Logic Signals

●●●▶ Chapter 6, “Triggering” in the user’s manual

The triggers can be classified into two main types: edge/state triggers and width triggers.

Edge/State trigger

Logic Edge

A trigger is activated when the signal of a specified bit (trigger source*) changes to the selected polarity.

▶Section 6.6

Logic Edge (Qualified)

A trigger is activated when a logic edge trigger condition is met while the signal status of each bit is meeting a specified condition (qualification).

▶Section 6.7

Logic State

A trigger is activated when the signal status of each bit meets or no longer meets a specified condition (state). A trigger can also be activated by checking the condition at the point of polarity change (edge) of a specified clock signal.

▶Section 6.8

Width trigger

Logic Pulse

A trigger is activated by determining whether the pulse width of the signal of a specified bit (trigger source) is longer or shorter than a specified determination time.

▶Section 6.10

Logic Pulse State

A trigger is activated when the relationship between the time over which the signal status of each bit meets or does not meet a specified condition (state) and the specified determination time is met. A trigger can also be activated by checking the condition at the point of polarity change (edge) of a specified clock signal.

▶Section 6.12

* Trigger source refers to the signal that is used in checking the trigger condition.

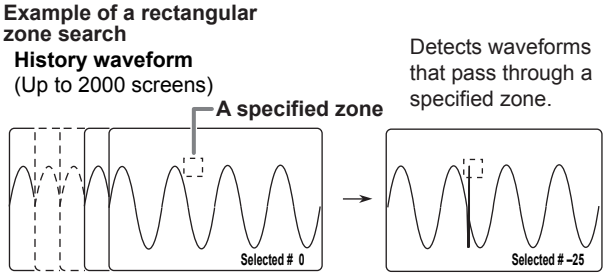
History Memory

●●●▶ Chapter 11, “Displaying and Searching History Waveforms” in the user’s manual

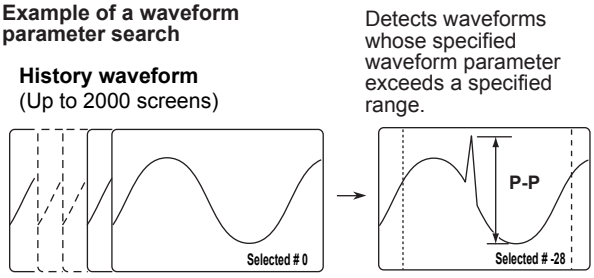
When waveforms are being measured, the waveform data in the acquisition memory that has been stored on trigger events is displayed as waveforms on the DL9500/DL9700 screen. When waveforms are acquired on continuous trigger events, it is impossible to stop the measurement in time when you notice an abnormal waveform (by that time newer waveforms are already on the screen). Normally, abnormal waveforms in the past cannot be displayed. However, by using the history memory function, the past waveform data (history waveforms) stored in the acquisition memory can be displayed when waveform acquisition is stopped. You can display a specific history waveform.
Additionally, you can search for a waveform that meets a specified waveform condition among the history waveforms. The following six conditions are available.

- Conditions for searching waveforms that passed (or not passed) a specified search zone
  Waveform zone, rectangular zone, or polygon waveform
- Conditions for searching waveforms whose measured values are within or outside a specified range.
  Waveform parameter values of automated measurement, FFT values, or area values of XY waveforms

Example of a rectangular zone search



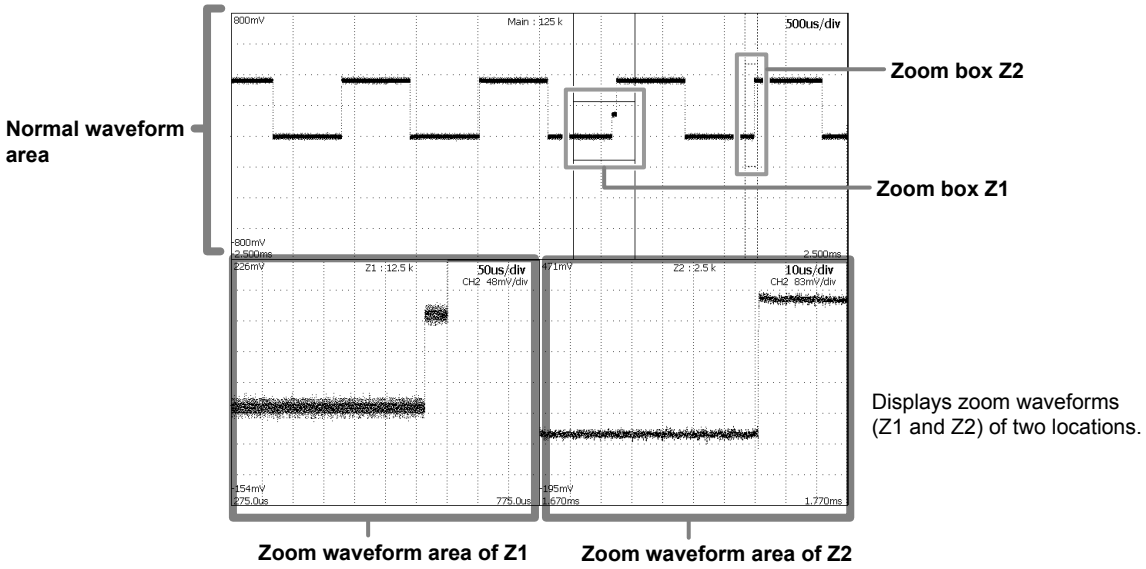
Example of a waveform parameter search



Zooming in on Waveforms

Section 8.1, “Zooming the Waveform” in the user’s manual

The displayed waveform can be expanded along the time or voltage axis. You can zoom in on two locations simultaneously. This function is useful when the waveform acquisition time is set long and you want to observe a particular section of the waveform closely. You can also set the zoom position (zoom box position).


Normal waveform area
Zoom box Z2
Zoom box Z1
Displays zoom waveforms (Z1 and Z2) of two locations.
Zoom waveform area of Z1
Zoom waveform area of Z2

Accumulated Display

Section 7.7, “Displaying Accumulation” in the user’s manual

The display time of old waveforms can be set longer than the waveform update period, so that newer waveforms appear overlapped (accumulated) on older waveforms. This feature is convenient when observing waveforms that include noise or jitter or observing phenomena that occur infrequently. The accumulated waveforms can be saved.
The following two modes are available.

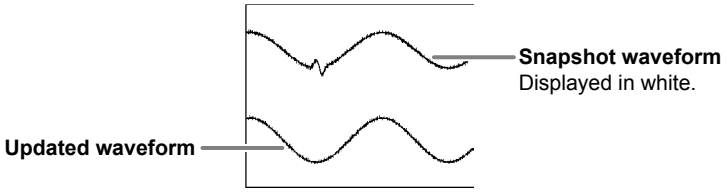
Count
Waveforms are accumulated the specified number of counts. The waveforms are displayed using different colors or intensities according to the frequency information of the data.

Time
Waveforms are accumulated over the specified time. The waveforms are displayed using different colors or intensities depending on how recent the data is.

Snapshot

Section 8.7, “Taking and Clearing Snapshots” in the user’s manual

The snapshot function allows you to temporarily hold a waveform that would be cleared when the screen is updated in update mode or a waveform that would move out of the waveform display area in roll mode. The snapshot waveform is displayed in white and can be compared against the updated waveform. The snapshot waveform can also be saved or printed as a screen image.
Press SNAP CLEAR to clear the snapshot waveform.



X-Y Waveform Display

Section 10.6, “Viewing the Phase Between Measured Waveform on the XY Display” in the user’s manual

The level relationship between two signals can be observed by assigning the signal level of a specified waveform on the X-axis (horizontal axis) and the signal level of another waveform (waveform whose display turned ON) on the Y-axis (vertical axis). Simultaneous observation of an X-Y waveform and a normal T-Y waveform (waveform using time axis and signal level) is also possible. Up to two X-Y waveforms can be displayed.

Reference Waveform

Chapter 14, “Displaying Reference Waveforms” in the user’s manual

History waveforms of input channels, computed waveforms, or waveforms saved to the internal memory can be displayed as reference waveforms in M1 to M4. Reference waveforms can be used in waveform computation.

Waveform Computation

Chapter 9, “Computation” in the user’s manual

The following operations are available: addition, subtraction, multiplication, linear scaling, integration, phase shift (display phase-shifted waveforms), moving average (smoothing), IIR filter, edge count, and rotary count. Up to eight computations can be assigned.

Cursor Measurement

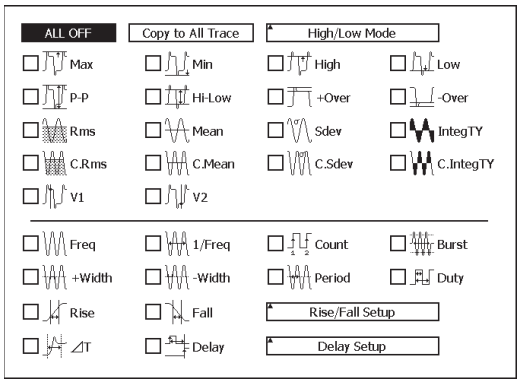
Section 10.1, “Making Cursor Measurements” in the user’s manual

Cursors can be placed on the displayed waveform, and various types of measured values at the intersecting point of the cursor and waveform can be displayed. There are six types of cursors: horizontal (H) cursors, vertical (V) cursors, horizontal & vertical (H&V) cursors, vertical time (VT) cursors, marker cursors, and serial cursor.

Automated Measurement of Waveform Parameters

Section 10.2, “Automated Measurement of Waveform Parameters” in the user’s manual

This feature automatically measures parameters such as the maximum waveform level and frequency. It can measure 30 waveform parameters (including delay between channels) related to the voltage (vertical) axis, time (horizontal) axis, and waveform area.



- Up to 16 arbitrary parameters can be displayed.
- A total of up to 100000 data values can be stored for all waveforms.
- The measured values of waveform parameters can be used in computations.

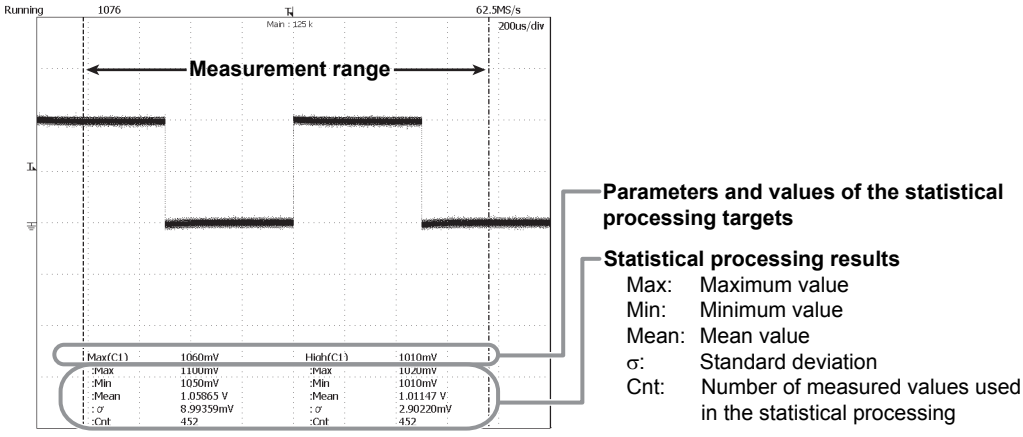
Statistical Processing

Section 10.3, “Performing Statistical Processing of the Measured Values of Waveform Parameters” in the user’s manual

Section 10.8, “Displaying a Histogram, Trend, or List of Automatic Measurement Waveform Parameters” in the user’s manual

Statistical processing for the following five items can be performed on three of the items measured through the automated measurement of waveform parameters.

Maximum value (Max), minimum value (Min), mean value (Mean), standard deviation (σ), and the number of measured values used in the statistical processing (Cnt).



The following three statistical processing modes are available.

Normal statistical processing

Measures the selected parameters on all acquired waveforms while acquiring waveforms and performs statistical processing.

Cyclic statistical processing (measurement and statistical processing per cycle)

Measures the selected parameters on the waveform per cycle from the left end to the right end of the screen (from the oldest waveform) and performs statistical processing.

Statistical processing of history data

Measures the selected parameters on the history waveform and performs statistical processing. Measurement and statistical processing are performed from the oldest data.

The measured results can be displayed as a list, trend, or histogram.

Telecom Test

●●●▶ Section 10.4, "Telecom Testing (Mask Test and Eye Pattern Measurement)" in the user's manual

There are two available tests. The mask test is used to analyze the communication signal. The other test automatically measures the waveform parameters of an eye pattern.
If you turn the telecom test ON, accumulated display (count mode) is automatically enabled. The mask test counts the waveforms that pass through a masked area. The mask pattern is created using a free software provided on the YOKOGAWA Website and loaded into the DL9500/DL9700.

Ethernet Interface

●●●▶ Chapter 15, "Ethernet Communications (Optional)" in the user's manual

You can use the Ethernet function (/C10 option) to transfer data and control the DL9500/DL9700.

Save/Load data on a network drive

The waveform and setup data can be saved and loaded and screen image data can be saved to an FTP server* on the network in the same way as with the PC card, internal hard disk (option), and external USB storage device.

* A PC or workstation running the FTP server function.

Print on a network printer

The screen image can be printed on a network printer in the same way as with the built-in printer or USB printer.

Mail transmission

You can send DL9500/DL9700 information via e-mail. You can also send information such as the trigger time in an e-mail as an action for the action-on-trigger function.

Access the DL9500/DL9700 from a PC or workstation

You can access the internal memory or internal hard disk (option) on the DL9500/DL9700 from a PC or workstation* on a network.

* A PC or workstation running an FTP client or Microsoft Network function.

Web server

The DL9500/DL9700 can operate as a Web server. By displaying the DL9500/DL9700 Web page, you can carry out basic operations on the DL9500/DL9700 such as monitor the DL9500/DL9700 screen on the Web page, capture a screen image, and start/stop measurements.

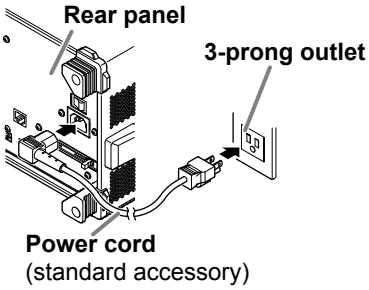
Preparation

This section describes preparations for observing waveform signals.

Connecting the Power Supply

Section 3.3, “Connecting the Power” in the user’s manual

To use the DL9500/DL9700 safely, read the warnings given in section 3.3, “Connecting the Power” in the user’s manual before connecting the power supply.



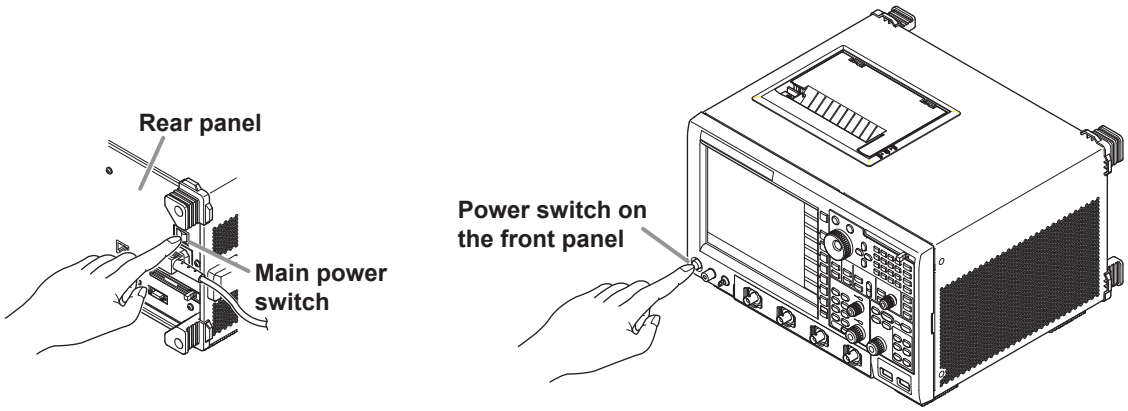
Rated supply voltage: 100 to 120VAC or 220 to 240 VAC
Rated supply voltage frequency: 50/60 Hz
Allowable supply voltage range: 90 to 132 VAC or 198 to 264 VAC
Allowable power supply frequency range: 48 to 63 Hz

Turning ON/OFF the Power Switch

Section 3.3, “Connecting the Power” in the user’s manual

Check that the power switch on the front panel is OFF before turning ON the main power switch.

Turn ON the main power switch on the rear panel and then the power switch on the front panel.



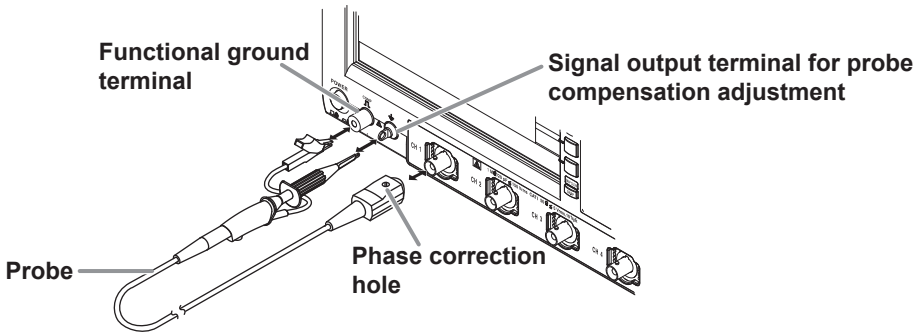
Connecting the Probes

Section 3.4, “Connecting the Probe” in the user’s manual
Section 3.5, “Compensating the Probe (Phase Correction)” in the user’s manual

To use the DL9500/DL9700 safely, read the warnings and cautions given in section 3.4, “Connecting the Probe” and section 3.5, “Compensating the Probe (Phase Correction)” in the user’s manual before connecting the probe.

To observe analog signal waveforms, connect a probe to the input terminal on the front panel. To observe logic signals, see “Connecting the Logic Probes” (next section).

- Connect a probe to the input terminal (CH1) of the DL9500/DL9700.
- Connect the probe tip to the probe compensation signal output terminal on the DL9500/DL9700 front panel.
- Connect the earth wire to the functional earth terminal.



Note

To actually observe waveforms, make sure to perform phase correction (section 3.5) and calibration (section 4.8) of the probe according to the instructions in the user’s manual. Otherwise, waveforms cannot be observed correctly.

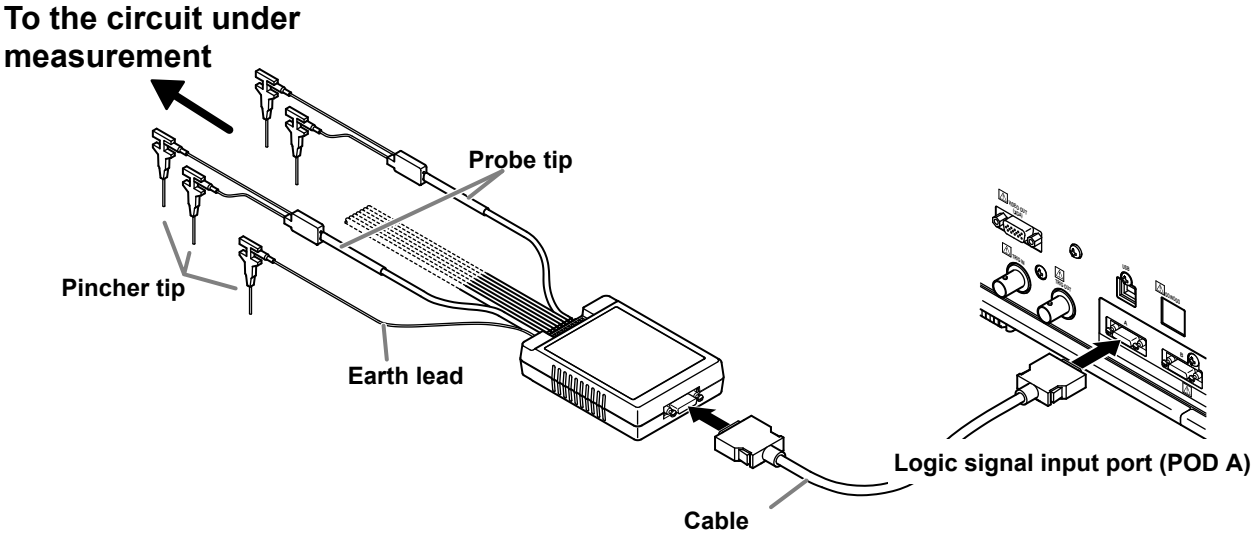
Connecting the Logic Probes

Section 3.6, “Connecting the Logic Probes” in the user’s manual

To use the DL9500/DL9700 safely, read the warnings and cautions given in section 3.6, “Connecting the Logic Probes” in the DL9500/DL9700 User’s Manual and those given in the user’s manual of the logic probe.

To observe logic signals, connect a logic probe to the logic signal input port on the rear panel. To observe analog signal waveforms, see “Connecting the Probes” (previous section).

- Turn OFF the power switch of the DL9500/DL9700.
- Connect the cable that was provided with the logic probe to the logic probe.
- Connect a probe tip, earth lead, pincher tip, or the like to the logic probe.
- Connect the other end of the cable that was connected to the logic probe to the logic signal input port (POD A) of the DL9500/DL9700.
- Turn ON the power switch of the DL9500/DL9700.
- Connect the pincher tip of the earth lead that was connected to the logic probe to the ground potential of the circuit under measurement.
- Connect the pincher tip of the probe tip that was connected to the logic probe to the circuit under measurement.



Observing the Analog Signal Waveforms

This section describes the procedure to observe analog signal waveforms. For the procedure to observer logic signals, see page 27.

Carry out the following work before continuing with the subsequent procedure.

Apply the probe compensation signal that the DL9500/DL9700 generates to the CH1 input terminal in order to observe analog signal waveforms. For the procedure to connect the probe to the input terminal, see "Connecting the Probes" on page 17 in this operation guide.

Displaying Waveforms on the Screen

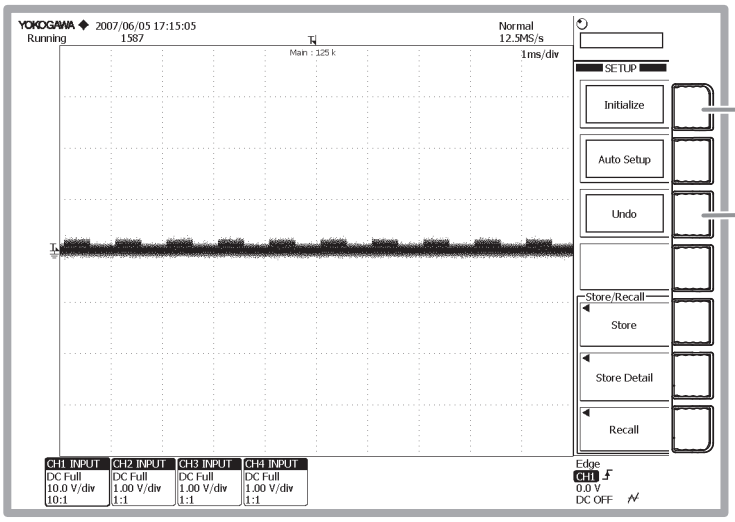
This section explains the setup initialization and auto setup that are convenient when displaying typical repetitive waveforms such as sine and rectangular waves.

Initializing the Settings

Section 4.4, "Initializing Settings" in the user's manual

We will reset the settings that have been entered using the front panel keys to factory default values.
This operation is not necessary if you are using the DL9500/DL9700 for the first time after purchase. However, we recommend that you carry out the operation for your learning experience. This initialization operation is useful when you want to redo the settings from scratch based on the input signal.

SETUP — **1** Press **SETUP**.



2 Press the **Initialize** soft key.
Initialization is executed.

Press here to set the DL9500/DL9700 back to the condition that existed immediately before the initialization.

Note

- If you initialize the DL9500/DL9700, all channel displays are turned ON and data acquisition starts.
- The items that cannot be initialized using the Initialize soft key are as follows:
  Date/time settings, communication settings, setup data and waveform data stored in the internal memory, and language settings
- To initialize all the settings excluding the date/time settings and the setup data and waveform data stored in the internal memory, carry out the procedure below.
  Note that this procedure cannot be undone.
  [Turn ON the power switch while holding down the RESET key]

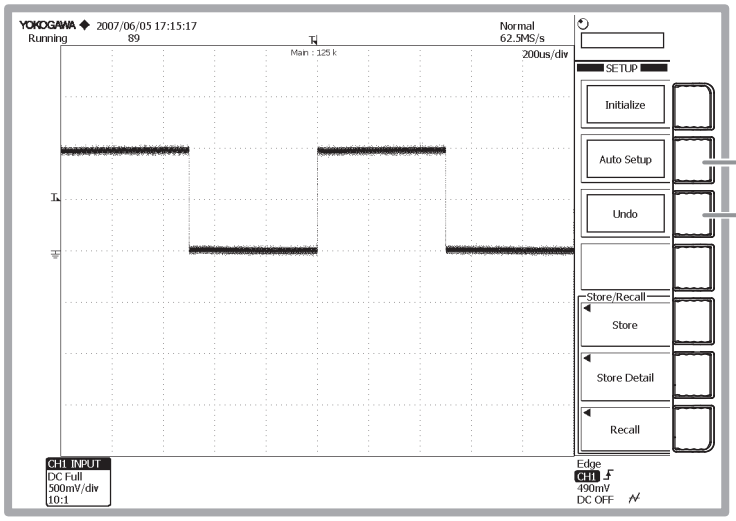
Performing Auto Setup

Section 4.5, “Performing Auto Setup” in the user’s manual

Vertical axis (voltage axis), horizontal axis (time axis), trigger, and other settings are automatically configured based on the input signal.
This feature is useful when you want to quickly display the waveform or when you do not know the setup conditions because the characteristics of the input signal are unknown.

SETUP

1 Press **SETUP**.



2 Press the **Auto Setup** soft key.
Auto setup is executed.

Press here to set the DL9500/DL9700 back to the condition that existed immediately before auto setup.

Note

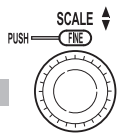
- When auto setup is executed, only the waveforms of the channels in which signals are being applied are displayed.
- Auto setup is possible on the following waveform.
  Frequency: Approximately 50 Hz or higher. Absolute value of the input voltage: The maximum value is greater than or equal to 20 mV (1:1). Type: Repetitive waveform (not complicated).

Changing the Waveform Display Conditions

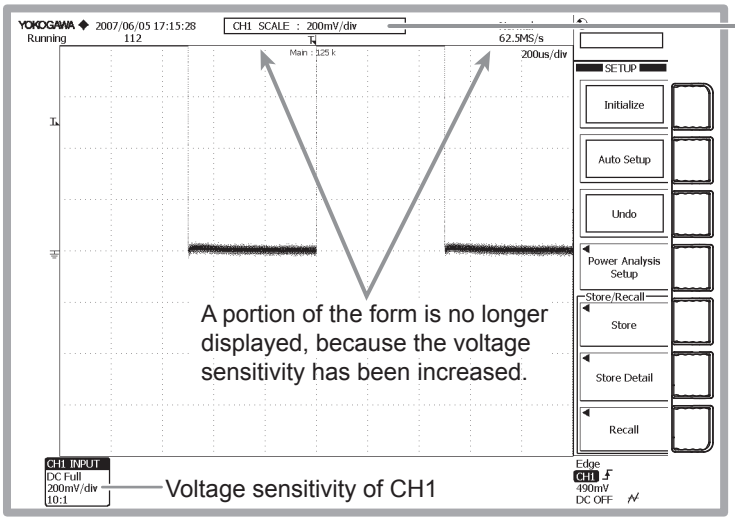
This section explains how to change the settings such as the display format; voltage sensitivity and vertical position (vertical axis settings); and time axis (horizontal axis setting).

Changing the Voltage Sensitivity from 500 mV/div to 200 mV/div

●●●▶ Section 5.7, "Setting the Scale" in the user's manual



1 Turn the **SCALE knob** clockwise to set the voltage sensitivity to 200 mV/div.



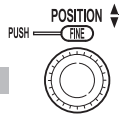
The setting that is being changed is displayed temporarily.

Note

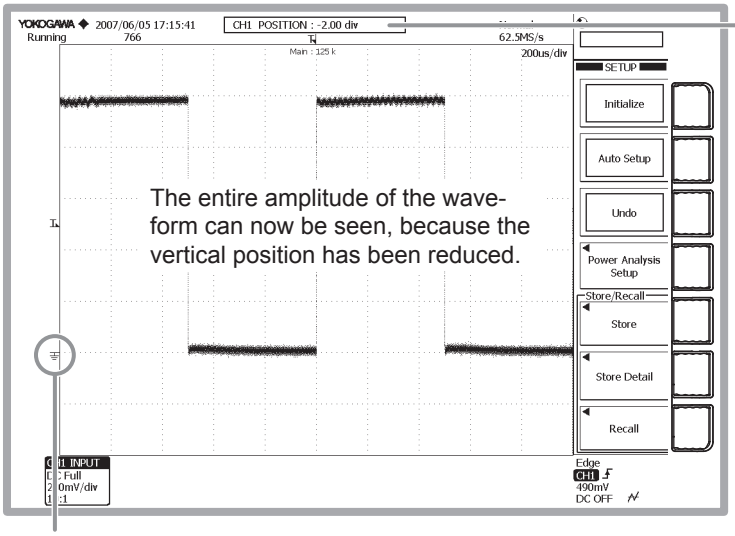
If multiple waveforms are displayed, press the CH1 key so that CH1 can be controlled using the SCALE knob.

Lowering the Vertical Position for Viewing the Entire Amplitude of a Waveform

●●●▶ Section 5.3, "Setting the Vertical Position of the Waveform" in the user's manual



1 Turn the **POSITION knob** counterclockwise to set the vertical position to –2.00 div.



The setting that is being changed is displayed temporarily.

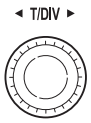
Note

If multiple waveforms are displayed, press the CH1 key so that CH1 can be controlled using the POSITION knob.

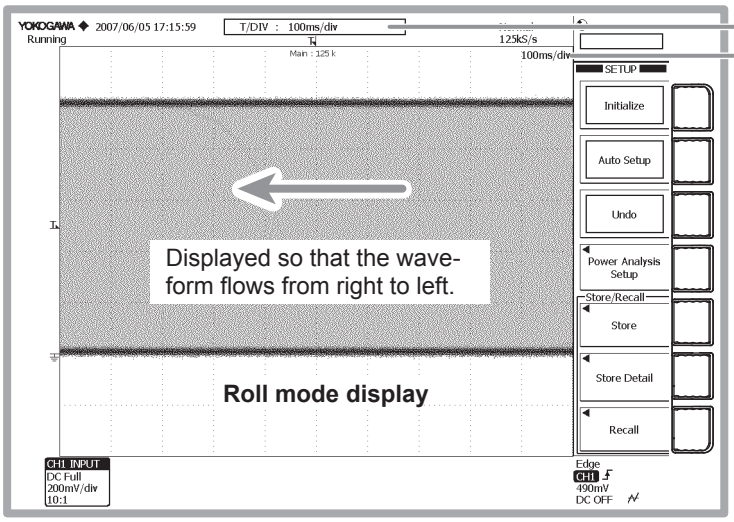
Changing the Time Axis Setting from 200 μs/div to 100 ms/div

Section 5.8, “Setting Time Axis (T/div)” in the user’s manual

Time axis setting refers to setting of the time per division of the grid.
If the time axis setting is increased when the trigger mode is set to Auto or Auto Level, the screen display changes from update mode in which the waveform display is refreshed at given intervals to roll mode in which the waveforms flow from right to left on the screen.
Roll mode display is useful when observing signals with a long period or signals with slow changes.



1 Turn the **T/DIV knob** counterclockwise to set the time axis to 100 ms/div.



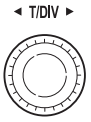
The setting that is being changed is displayed temporarily.

Time axis setting

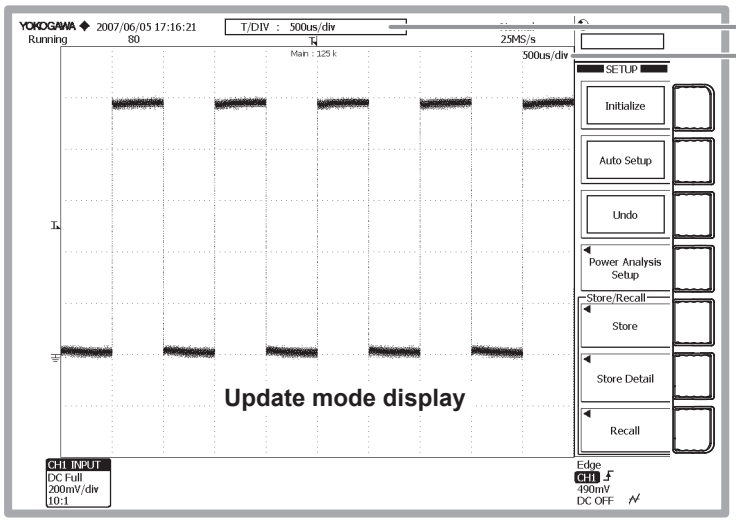
Changing the Time Axis Setting from 100 ms/div to 500 μs/div

Section 5.8, “Setting Time Axis (T/div)” in the user’s manual

The screen display switches back from roll mode display to update mode display and shows five periods of the waveform.



1 Turn the **T/DIV knob** clockwise to set the time axis to 500 ms/div.



The setting that is being changed is displayed temporarily.

Time axis setting

Changing the Trigger Settings

Trigger setting determines the time position of the acquired signal to be displayed as a waveform.
The main trigger settings are indicated below.

Trigger Type
The triggers can be classified into three main types: edge/state triggers, width triggers, and enhanced triggers. For details, see page 11 in this operation guide.

Trigger Source
Trigger source refers to the signal that is used to check the trigger condition.

Trigger Slope
Trigger slope refers to the movement of the signal from a low level to a high level (rising edge) or from a high level to a low level (falling edge). If the slope is used as one of the trigger conditions, it is called a trigger slope. Edge refers to the point where the trigger source slope passes through the trigger level.

Trigger Level
Trigger level refers to a given level at which a trigger is activated when the trigger source passes this level. With simple triggers such as the edge trigger (see page 11 in this operation guide), a trigger is activated when the trigger source level passes through a specified trigger level.

Trigger Mode
Trigger mode specifies the conditions (timing or count) for updating the displayed waveform. If auto setup is performed, the trigger mode is set to Auto. There are five trigger modes. For details, see section 6.1, “Setting the Trigger Mode” in the user’s manual.

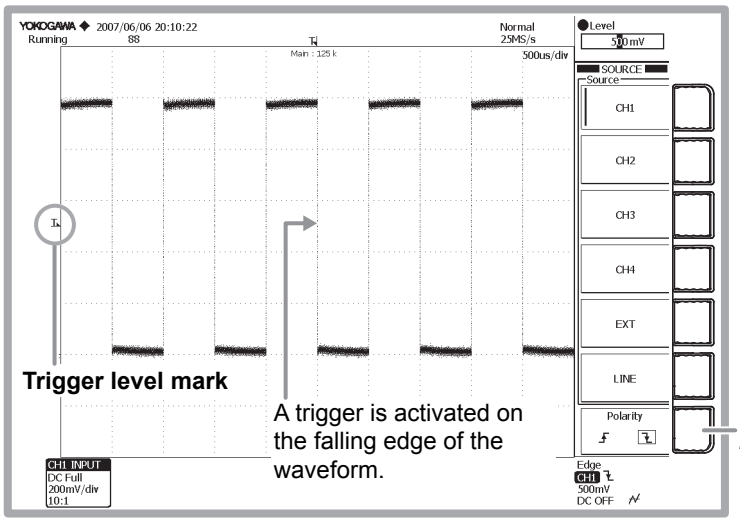
Trigger Position
When you start waveform acquisition, a trigger is activated based on a specified trigger condition, and the waveform acquired to the acquisition memory is displayed. By moving the trigger position on the screen, the ratio of the data before the trigger point (pre data) and the data after the trigger point (post data) can be changed. The default value is 50.0% (center of the screen).

If the settings are initialized or auto setup is executed, the trigger type is set to edge/state (trigger source: CH1 edge trigger).
The edge trigger activates a trigger on a rising or falling edge of a single input signal.
This section explains how to change the trigger slope, trigger mode, and trigger position while keeping the trigger type at edge trigger.

Changing the Trigger Slope from Rising to Falling

Section 6.6, “Activating an Edge Trigger” in the user’s manual

SOURCE — **1** Press **SOURCE**.



2 Select ↓ (falling edge).

Note

- Check that the Edge/State key is illuminated.
- The menu that appears when you press the SOURCE key varies depending on the trigger type.

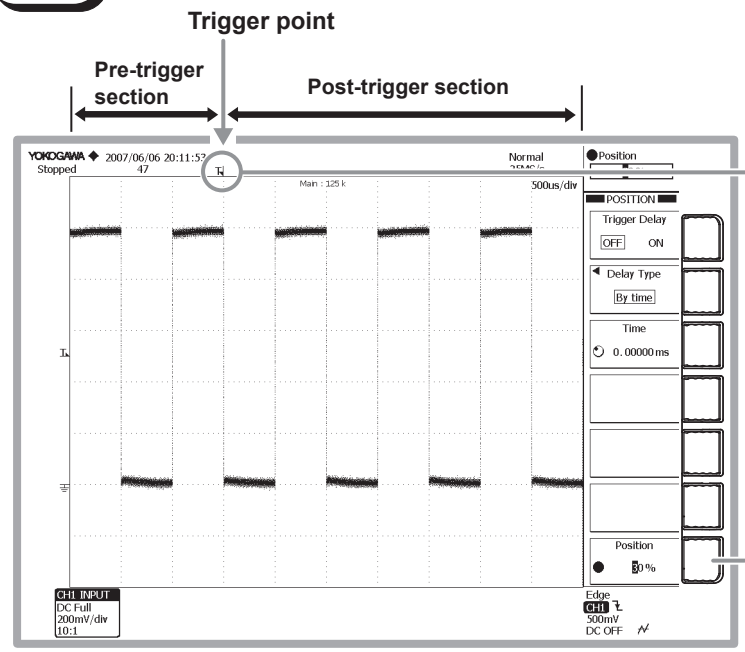
Moving the Trigger Position Left by 2 Divisions

Section 6.2, “Setting the Trigger Position” in the user’s manual

The waveform moves to the left by 2 divisions showing more of the waveform after the trigger occurrence (post-trigger section).

POSITION/DELAY

1 Press **POSITION/DELAY**.



2 Turn the **rotary knob** counterclockwise to set the trigger position to 30%.

Changing the Trigger Mode from Auto to Single

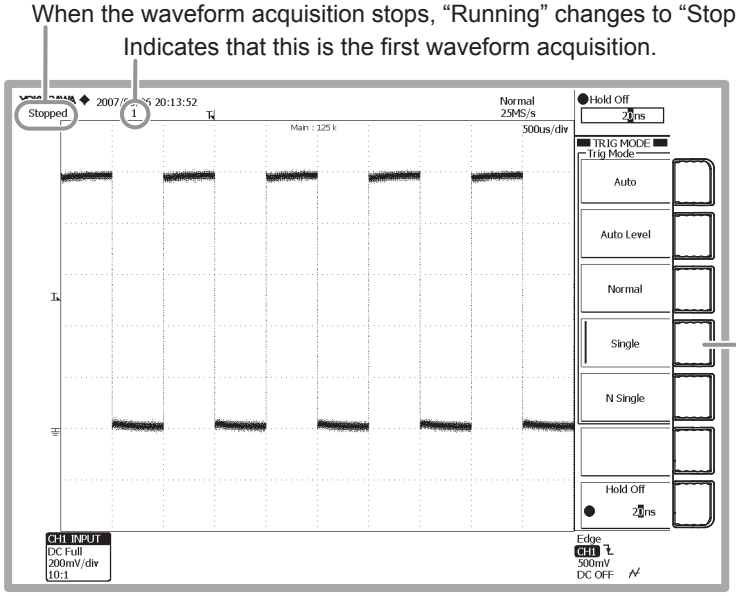
Section 6.1, “Setting the Trigger Mode” in the user’s manual

In Single mode, the displayed waveforms are updated only once when a trigger is activated, and acquisition stops.
Single mode is suited for observing single shot signals.

ACQ COUNT/ACTION

TRIG MODE/HOLD OFF

1 Press **TRIG MODE/HOLD OFF**.



2 Select **Single**.

Measuring Waveforms

This section explains how to measure the voltage and period of the displayed waveform using the vertical cursors. Automated measurement of waveform parameters, computation, and other functions are also available for measuring pulse and other waveforms.

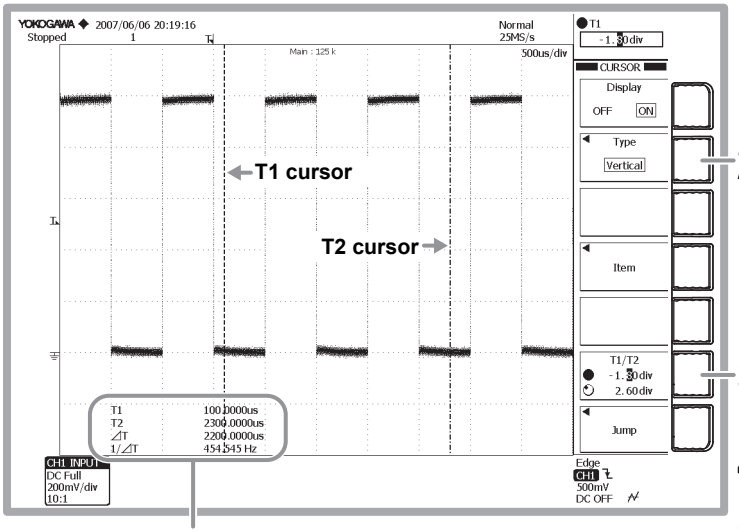
Measuring the Voltage Using the Vertical Cursors

Section 10.1, "Making Cursor Measurements" in the user's manual

The voltage (vertical axis value or Y-axis value) and time (horizontal axis value or X-axis value) at the cursor position are displayed in the lower section of the waveform area.

CURSOR

1 Press **CURSOR**.



2 Display the selection menu and select Vertical.

3 Select T1 cursor so that it can be controlled using the rotary knob.

4 Turn the **rotary knob** to move the T1 cursor.

5 Likewise, move the T2 cursor.

If you select both T1 cursor and T2 cursor, the two cursors can be moved simultaneously using the rotary knob.

T1: The X-axis value at the T1 cursor
T2: The X-axis value at the T2 cursor
ΔT: The difference between the X-axis values of T1 and T2 cursors
1/ΔT: The inverse of the difference between the X-axis values of T1 and T2 cursors

Note

Cursor types

Vertical cursors	Measures the X-axis value at the cursor position.
Horizontal cursors	Measures the Y-axis value at the cursor position.
Vertical & horizontal cursors	Measures the X- and Y-axes values at the cursor position.
VT cursors	Measures the time from the trigger position to the cursor position and the Y-axis value at the cursor position of each waveform.
Marker cursors	Measures the X- and Y-axes values of the waveform. The marker cursors move on the waveform. M1 (Marker 1) to M4 (Marker 4) can be set on different waveforms.
Serial cursor	Displays the Y-axis value at the cursor position with respect to a specified level as 0 or 1. You can set the bit rate, the number of bits to be displayed, and so on.

Zooming in on Waveforms

This section explains how to expand a section of the displayed waveform along the time (horizontal) axis. Though not covered in this operation guide, you can also expand the voltage (vertical) axis.

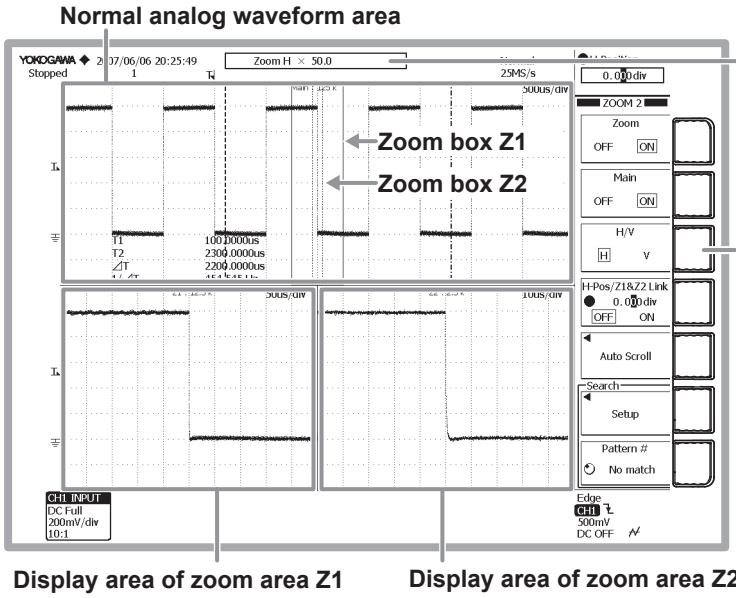
Setting the Time (Horizontal) Zoom Ratio

Section 8.1, "Zooming the Waveform" in the user's manual

Normal waveforms and zoomed waveforms of two locations can be displayed simultaneously. When zoom waveforms are displayed, zoom boxes indicating the zoom range and position are displayed in the normal analog waveform area.

DISP 1 / DISP 2 → ZOOM 1 / ZOOM 2

1 Press **ZOOM 1** or **ZOOM 2**.



The setting that is being changed is displayed temporarily.

Press ZOOM 1 to set the zoom ratio of Z1. Press ZOOM 2 to set the zoom ratio of Z2.

2 Select zoom direction H.

3 Turn the **MAG knob** to set the zoom ratio.

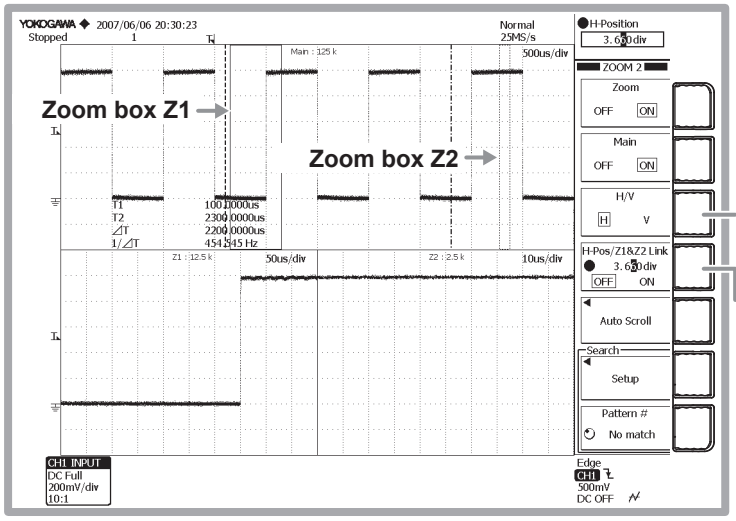
Moving the Zoom Position along the Time (Horizontal) Axis

Section 8.1, "Zooming the Waveform" in the user's manual

Move the zoom position while viewing the zoom box.

DISP 1 / DISP 2 → ZOOM 1 / ZOOM 2

1 Press **ZOOM 1** or **ZOOM 2**.



Press ZOOM 1 to move the zoom box Z1 position. Press ZOOM 2 to move the zoom box Z2 position.

2 Set the movement direction of the zoom box to H.

3 Turn OFF the Z1 and Z2 zoom box link.

4 Turn the **rotary knob** to move the zoom box.

Note

If you turn ON the Z1 and Z2 zoom box link in step 3, you can move the two zoom boxes simultaneously.

Observing Logic Signals

This section describes the procedure to observe logic signals. For the procedure to observer analog signal waveforms, see page 19.

Carry out the following work before continuing with the subsequent procedure.

- **To observer a logic signal, prepare a logic signal of approximately 1-V amplitude and 1-kHz frequency and apply it to the logic signal input port (POD A) of the DL9500/DL9700.**
- **Use YOKOGAWA's 701981 or 701980 logic probe to connect to the input port. To match the input conditions of the logic signal to those used in this operation guide, apply the logic signal that you prepared to bits 0, 1, 2, and 4 of the logic probe. Bits 0, 1, 2, and 4 correspond to bits A0, A1, A2, and A4 of POD A, respectively.**
- **For the procedure to connect a logic probe to the input port, see "Connecting the Probes" on page 18 in this operation guide.**

Displaying Logic Waveforms on the Screen

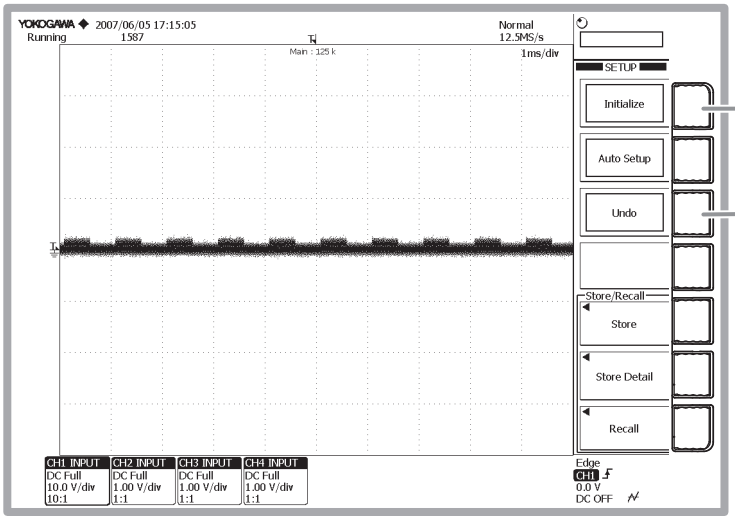
The auto setup function of the DL9500/DL9700 only supports analog signals. Therefore, you must set the trigger source, trigger type, and threshold level to acquire and display the input logic signals.
First, we will initialize the settings and set the trigger source to bit A0. Then, we will set the trigger type and threshold level on the next page.

Initializing the Settings

Section 4.4, "Initializing Settings" in the user's manual

We will reset the settings that have been entered using the front panel keys to factory default values. By factory default, the trigger source of the logic signal is set to bit A0.
This operation is not necessary if you are using the DL9500/DL9700 for the first time after purchase. However, we recommend that you carry out the operation for your learning experience. This initialization operation is useful when you want to redo the settings from scratch based on the input signal.

SETUP — **1** Press **SETUP**.



2 Press the **Initialize** soft key.
Initialization is executed.

Press here to set the DL9500/DL9700 back to the condition that existed immediately before the initialization.

Note

- If you initialize the DL9500/DL9700, all channel displays are turned ON and data acquisition starts.
- The items that cannot be initialized using the Initialize soft key are as follows:
  Date/time settings, communication settings, setup data and waveform data stored in the internal memory, and language settings
- To initialize all the settings excluding the date/time settings and the setup data and waveform data stored in the internal memory, carry out the procedure below.
  Note that this procedure cannot be undone.
  [Turn ON the power switch while holding down the RESET key]

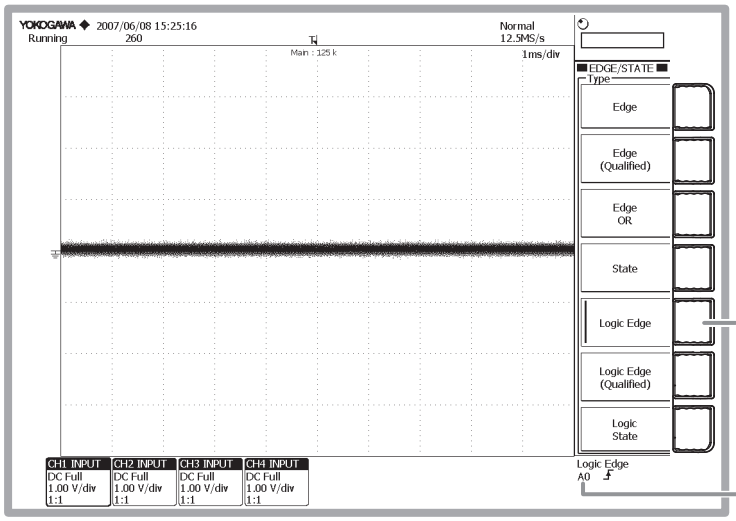
Setting the Trigger Type to Logic Edge

Section 6.6, “Activating an Edge Trigger” in the user’s manual

Because we are applying an approximately 1-kHz logic signal, we set the trigger type to Logic Edge.

EDGE/STATE

1 Press **EDGE/STATE**.



2 Select **Logic Edge**.

If you execute the initialization procedure explained on the previous page, the trigger source of the logic signal is set to bit A0. A logic signal of approximately 1-V amplitude is applied to bit A0.

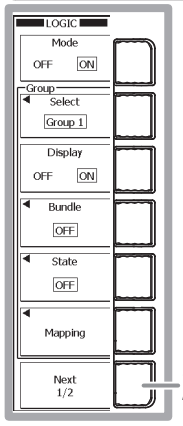
Setting the Threshold Level to 0.5 V

Section 5.18, “Setting the Threshold Level” in the user’s manual

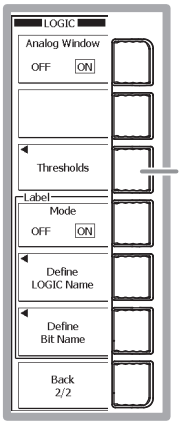
Because we applying a logic signal of approximately 1-V amplitude, we set the threshold level to 0.5 V.

LOGIC

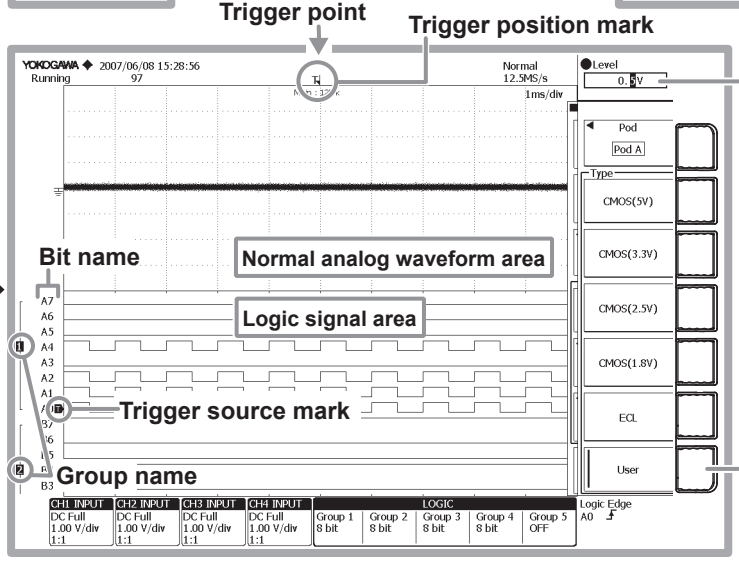
1 Press **LOGIC**. The screen is divided into top and bottom halves, and the logic signal area is displayed in the bottom half.



2 Display the next menu.



3 Display the threshold level setup menu.



4 Select **User**.

5 Turn the **rotary knob** clockwise to set the threshold level to 0.5 V.

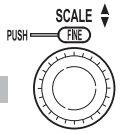
The logic signal is acquired allowing you to view the signal.

Changing the Display Conditions for Logic Signals

This section explains how to set the vertical display size and vertical position of the logic signal and how to change the bus display.

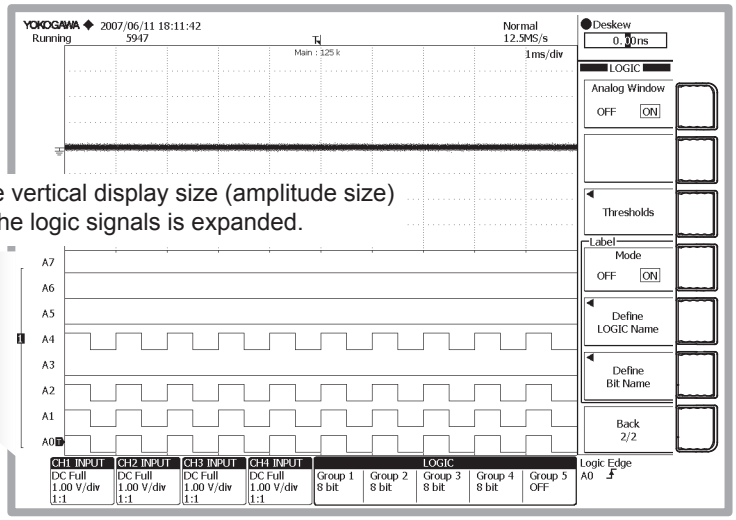
Maximizing the Display Size

●●●▶ Section 5.16, “Setting the Display Size and Vertical Position of Logic Signals” in the user’s manual



1 Turn the **SCALE knob** clockwise to make the vertical display size the maximum.

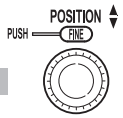
You can feel a click sensation when you turn the SCALE knob. Turn the knob by confirming each click. There are five levels of display size (amplitude size). The maximum display size will be obtained if you turn the SCALE knob clockwise for two clicks from the display size shown on page 28 of this operation guide.



The vertical display size (amplitude size) of the logic signals is expanded.

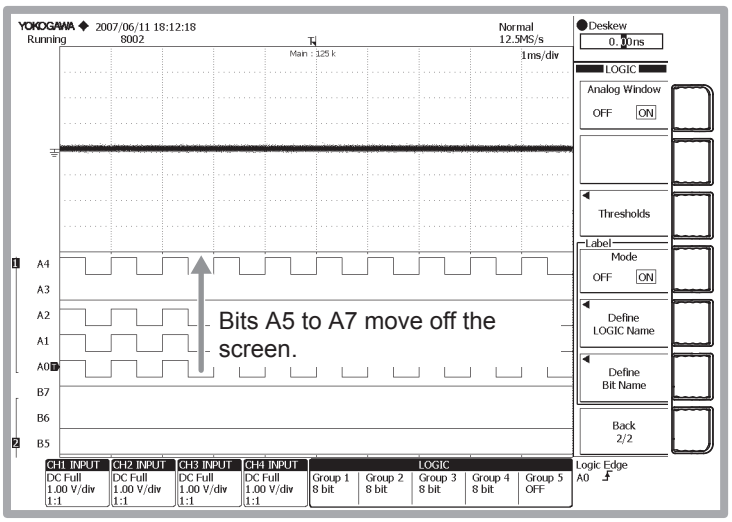
Moving the Vertical Position Upward

●●●▶ Section 5.16, “Setting the Display Size and Vertical Position of Logic Signals” in the user’s manual



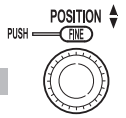
1 Turn the **POSITION knob** clockwise to move the vertical position upward.

You can feel a click sensation when you turn the POSITION knob. Turn the knob by confirming each click. If you turn the knob three clicks from the maximized display condition of the previous section, the vertical position moves upward and bits A5 to A7 move off the screen.



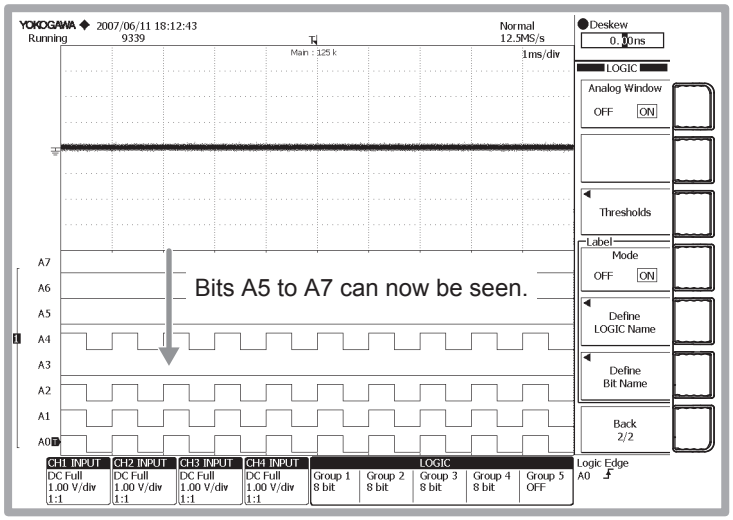
Moving the Vertical Position Downward

●●●▶ Section 5.16, “Setting the Display Size and Vertical Position of Logic Signals” in the user’s manual



1 Turn the **POSITION knob** counterclockwise to move the vertical position downward.

You can feel a click sensation when you turn the POSITION knob. Turn the knob by confirming each click. If you turn the knob counterclockwise three clicks from the condition in which the vertical position was moved upward in the previous section, the vertical position moves downward, and bits A5 to A7 appears on the screen.

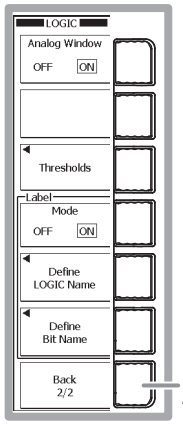


Changing from Bit Display to Hexadecimal Bus Display

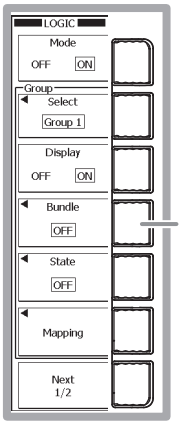
●●●▶ Section 5.17, “Enabling the Bus Display, Displaying the State, Mapping Bits to Groups” in the user’s manual

1 Press **LOGIC**.

Here, we return to the previous menu from the threshold level setup menu described on page 28 in this operation guide and set the bus display.



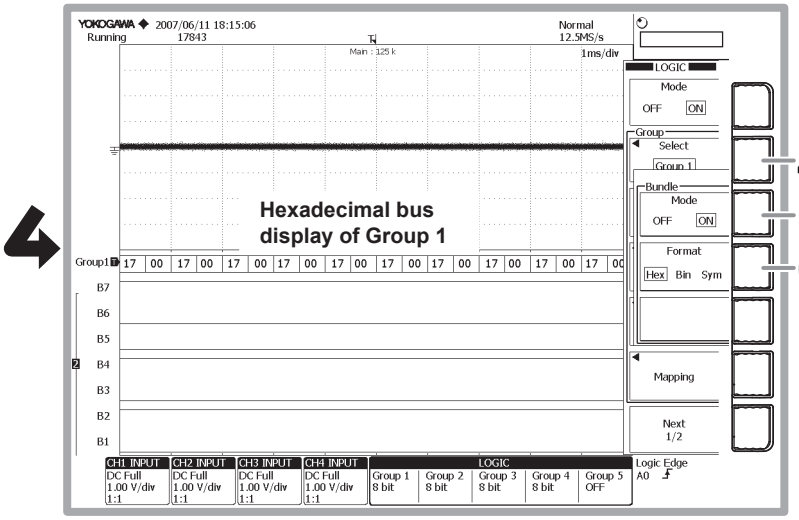
2 Display the previous menu.



3 Display the bus display setup menu.

Next Page

We will change the logic signal of Group 1 from bit display to hexadecimal bus display.



Note

- A group is a set of logic signals. The bit signals of the logic signal input port can be assigned to a group from the highest to the lowest digit as necessary. Up to five groups can be created. For details, see section 5.17 in the user's manual.
- A state display function is available. This function acquires the status of a logic signal on the point of polarity change (edge) of a specified clock signal. The state is held until the next clock occurs even if the input logic signal changes. For details, see section 5.17 in the user's manual.

Changing the Trigger Settings

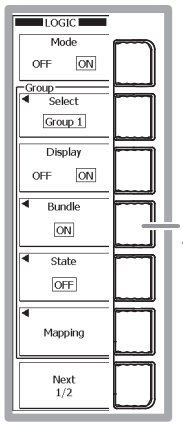
For a description of the main trigger setting items, see page 23 in this operation guide.

Changing the Trigger Polarity to “High to Low”

Section 6.6, “Activating an Edge Trigger” in the user’s manual

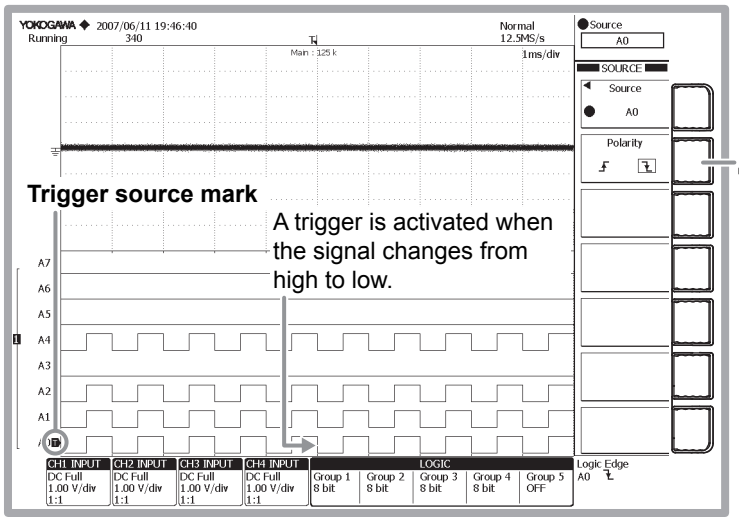
This section explains how to change the trigger polarity. For easier viewing of the changes in the acquired signal, we will turn OFF the bus display that was set in the previous section and then change the polarity.

1 Press **LOGIC**.



2 Display the selection menu and select OFF.

3 Press **SOURCE**.



4 Select ↓ (from high to low).

Note

- Check that the Edge/State key is illuminated.
- The menu that appears when you press the SOURCE key varies depending on the trigger type.

Measuring Logic Signals

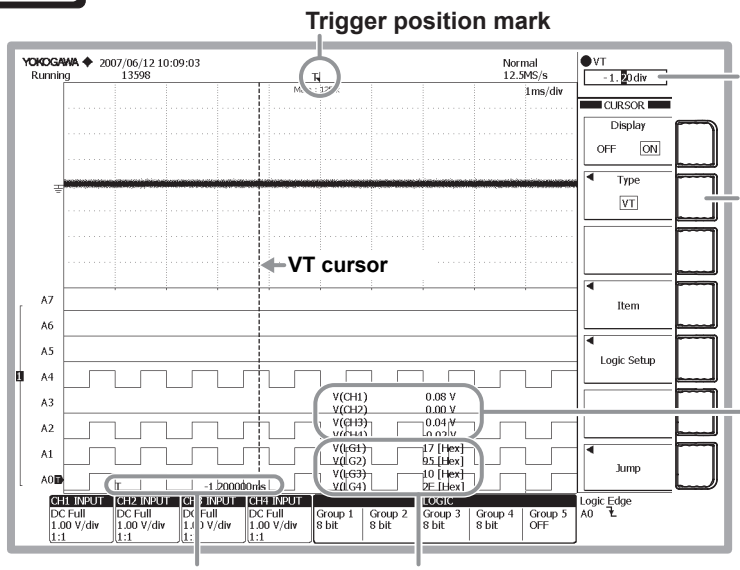
Logic signals can be measured using VT cursors. This section explains how to use these cursors.

Reading Logical Values Using VT Cursors

Section 10.1, “Making Cursor Measurements” in the user’s manual

The logical values of the logic signals at the cursor position are displayed in the lower section of the waveform area.

CURSOR **1** Press **CURSOR**.


Trigger position mark
VT cursor
3 Turn the rotary knob to move the VT cursor.
2 Display the selection menu and select VT.
The measured values of the analog waveform.
For details, see section 10.1 in the user’s manual.
T: The time from the trigger position to the cursor position
V(LG1): Logical value of logic signal Group 1
V(LG2): Logical value of logic signal Group 2
V(LG3): Logical value of logic signal Group 3
V(LG4): Logical value of logic signal Group 4

Note

Cursor types

In addition to the VT cursors describe above, there are other cursors: vertical cursors, horizontal cursors, horizontal & vertical cursors, marker cursors, and serial cursor. Horizontal cursors, horizontal & vertical cursors, marker cursors, and serial cursor can only be applied to analog waveforms. For an overview of the measured information, see page 25 in this operation guide.

Printing/Saving Waveforms

This section explains how to print the displayed waveform on the built-in printer (/B5 option) and save the waveform on a storage medium. Printing is also possible on a USB printer or a network printer (/C8 or /C10 option).
You can also save data to a flash ATA card (PC card TYPE II) or compact flash (using the PC card TYPE II adapter) using the built-in PC card interface. The data can also be saved to a network drive (/C8 or /C10 option).

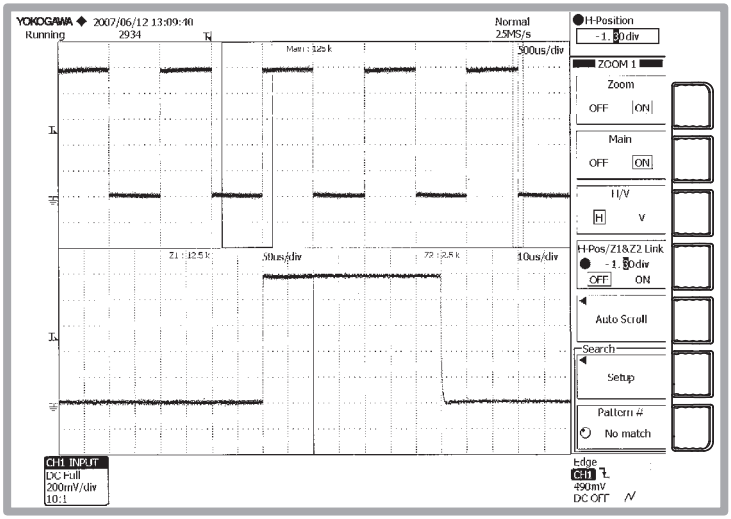
Printing the Screen Image on the Built-in Printer

Section 12.2, "Printing Using the Built-in Printer (Optional)" in the user's manual

Waveforms displayed on the screen are printed as shown. The printer icon at the lower left of the screen blinks while the image is being printed.
Before printing, load the roll paper according to the procedure given in section 12.1, "Installing the Roll Paper into the Built-in Printer (Optional)" in the user's manual.

PRINT — 1 Press **PRINT**. Printing is executed.

Print example

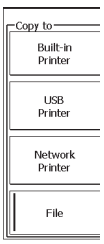


Note

Pressing SHIFT followed by PRINT displays the PRINT menu. You can select the print destination (built-in printer, USB printer, or network printer (option)) and save destination. You do not have to set them here.

PRINT menu

Press the Copy to soft key to display a selection menu.



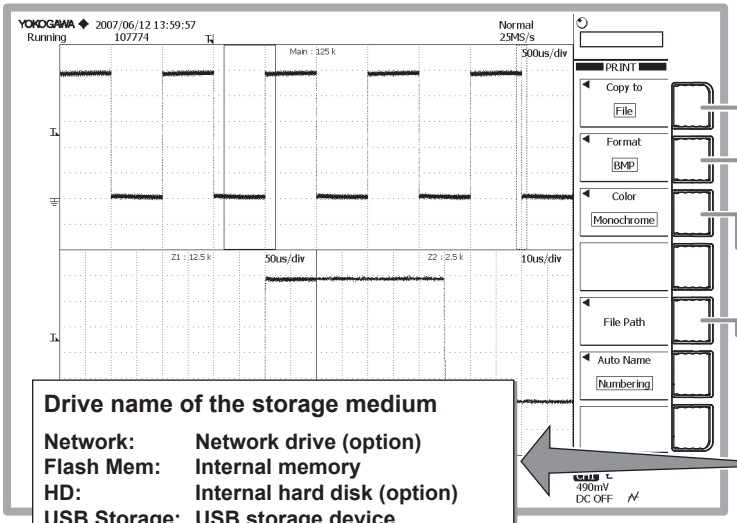
Saving the Screen Image Data to a Storage Medium

●●●▶ Section 13.9, "Saving Screen Image Data" in the user's manual

The screen image data is saved to the storage medium. The media access icon at the lower left of the screen blinks while the image is being saved.

MENU

SHIFT + PRINT —**1** Press **SHIFT** (the SHIFT key illuminates) and then **PRINT**.



Drive name of the storage medium

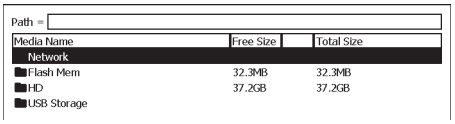
Network:	**Network drive (option)**
Flash Mem:	**Internal memory**
HD:	**Internal hard disk (option)**
USB Storage:	**USB storage device**
Storage Card:	**PC card**

2 Display the selection menu and select File.

3 Display the selection menu and select the data format.

4 Display the selection menu and select the color mode.

5 Open the dialog box and select the storage destination medium.



6 Press the **Open** soft key on the setup menu that appears simultaneously with the dialog box to confirm the file path to the selected storage medium.

ESC —**7** Press **ESC.** The dialog box closes.

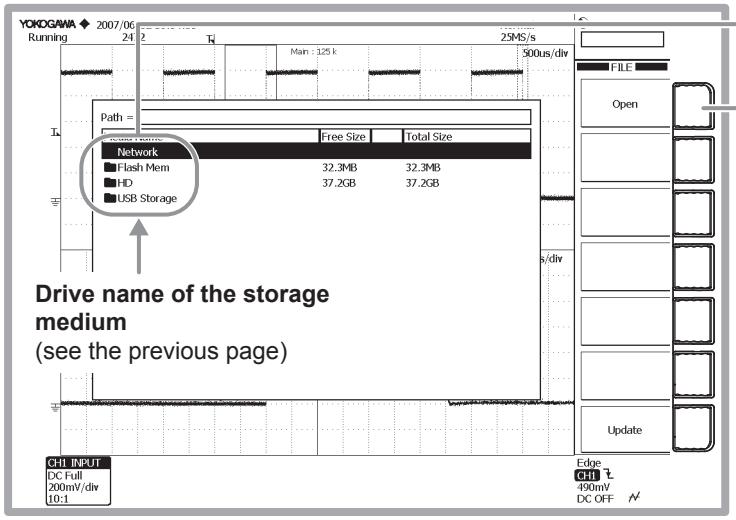
PRINT —**8** Press **PRINT** again. The save operation is executed.

Saving the Waveform Data to a Storage Medium

Section 13.5, “Saving/Loading the Measurement Data” in the user’s manual

The waveform data displayed on the screen is saved to a storage medium. When you execute the save operation, the setup data of the vertical axis, horizontal axis, and trigger of the saved waveform are also saved. The media access icon at the lower left of the screen blinks while the data is being saved.

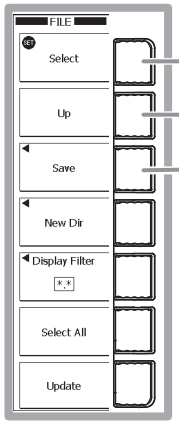
FILE — **1** Press **FILE**.



2 Turn the rotary knob to select the save destination medium.

3 Open the selected storage medium.

Drive name of the storage medium
(see the previous page)

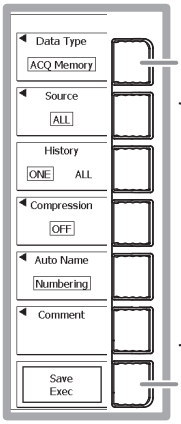


To save data to a specific folder, click here to confirm the folder you selected before opening the folder.

Press here to return to the higher level directory.

4 Display the Save menu.

Save menu



5 Set the data type to ACQ Memory.

These settings are not covered in this operation guide. As necessary, change the settings by referring to section 13.5 in the user’s manual.

6 Execute the save operation.